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ANTERIOR BOW-LEGS

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The literature of rachitic deformities of the legs in children, has not presented a case of extreme anterior bent tibias exhibiting a shortening of 10 cm. that has been corrected with a restoration to full length of the leg. After correcting many cases of anterior bent and shortened tibias with a lengthening of from 2.5 cm. to 10 cm. I feel justified in reporting upon them. Next to the correction of the deformity the patient that is dwarfed by anterior bent tibias prizes the restoration to normal stature. Anterior bent tibias so frequently complicate knock-knees and bow-legs that they cannot well be considered separately and occasionally these three deformities are so intermingled that it is a question which predominates.

Anterior bent tibia is seldom exclusively an anterior deformity except in the earliest stage for the reason that as the deformity progresses it usually goes to one side or other in the direction of the least resistance.

The most frequent type of anterior bent tibia is well shown in Fig. 1 (case 1.). The right tibia has a bend directly to the front and the left tibia has an out bend just as marked as its anterior bend. It will be seen that the apices of both deformity bends are close to the ankle joints. The fracturing bar of the Grattan osteoclast was placed against the outside of the legs and on a level with the apices of the deforming bends of the tibias.

After the lateral fracturing has been made complete the legs were straightened by manual force, causing the opening of triangular spaces in the posterior tibial shafts and the legs were fixed in plaster of Paris. The tendo Achilles of both legs had been previously tenotomized to permit of 2.5 cm. of lengthening. Six weeks later the patient, Fig. 2 (case 1.) was walking with symmetrical and perfectly functionating legs.

Occasionally the deformity of rachitic anterior bent tibia is so extreme in a child of from five to ten years of age that the distance from the heel to the posterior knee articulation is shortened over one half, making it evident that if a correction could be immediately accomplished it would destroy the vitality of the leg.

Fig. 3 (case 2.) shows a boy ten years of age with viciously deforming rachitic anterior and lateral bent tibias with all the

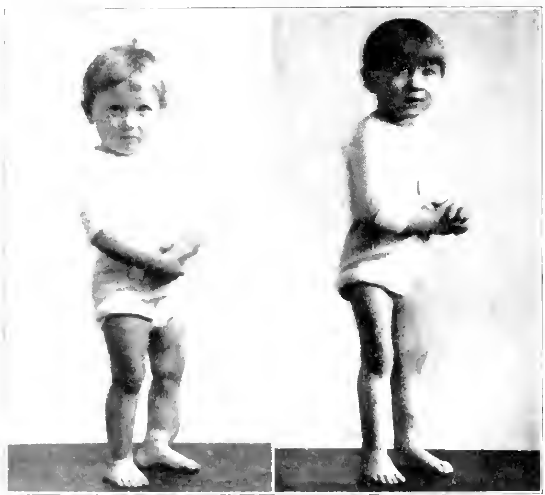

FIG. 1 (case 1) Boy aged 5 years with anterior bent tibias of the usual type.

FIG. 2 (case 2)—Six weeks after correction by rapid osteoclasis and with a lengthening of 2.5 cm.

ankle and foot articulations deranged. The roentgenogram of the case, Fig. 4, shows the extent of the anterior bends in the tibias and fibulas and also the shortening of the legs. In this case the legs were straightened and lengthened 2.5 cm. at a time without in the least endangering the vitality of the parts. Four osteoclases were done at different levels and three or four months apart. Each lengthening of the tibia was accompanied by a simple transverse tenotomy of the tendo Achilles to permit of its lengthening to a corresponding degree. The other fibrous tissues as well as the arteries and nerves stretched without any unpleasant symptoms. Six weeks after each osteoclasis the plaster of Paris was removed and the 2.5 cm. of gap in the tendo Achilles was found to be filled with connective tissue and the tendon was practically reproduced.

Ample experience shows that three or four lengthenings of the tendo Achilles by simple division leaves its strength unimpaired. Experience also shows that the nerves and arteries do not suffer in the least from 10 cm. of lengthening if done 2.5 cm. at a time and three or four months apart. Fig. 5 shows case 2 after four osteoclases with accompanying tenotomies of the tendo Achilles in each leg resulting in functionally perfect legs with 10 cm. of lengthening.

Nearly half the cases of badly deforming knock-knees are accompanied by more or less pronounced anterior bends in the tibias. In the correction of the knock-knees by supracondyloid osteoclasis the direction of the tibias is so changed that in fully two-thirds of the cases the accompanying bent tibias are so nearly neutralized as to be practically obliterated. This is very well shown in Fig. 6 and 7 (case 3.) before and six weeks after bloodless supracondyloid osteoclasis and redressement.

In about every seventh case of knock-knees with accompanying anterior bent tibias the correction of the knock-knees only accentuates the anterior bent tibias making necessary a separate osteoclasis and redressement for their correction.

Occasionally mild anterior bends in the tibias accompany badly deforming bow-legs that are automatically corrected with the correction of the dominating deformities by bloodless osteoclases. Such a case of pronounced bow-legs with mild anterior bent tibias is shown in Fig. 8. In this case the picture shows

FIG. 3 (case 2)—Boy aged 10 years with legs shortened one half by anterior and lateral bent tibias.

FIG. 4.—Roentgenogram of case 2, showing the pronounced anterior bends and the shortening of the tibias.

FIG. 5 (case 2)—Showing perfectly functionating legs with 10 cm. of lengthening.

the anterior tibias but poorly because the patient faces directly to the front. The same case is shown in Fig. 9 six weeks after correction of both the pronounced bow-legs and the mild anterior bent tibias by the one operation on each leg of bloodless osteoclasis. Frequently when the three deformities of rachitic bow-leg, knock-knee and anterior bent tibias are intermingled in the same leg the correction of two of the deformities automatically corrects the third.

Non-unions after accidental or spontaneous fractures that are so frequently seen in the fragile bones of acute rickets are a constant warning against doing either an osteoclasis or osteotomy until eburnation is complete.

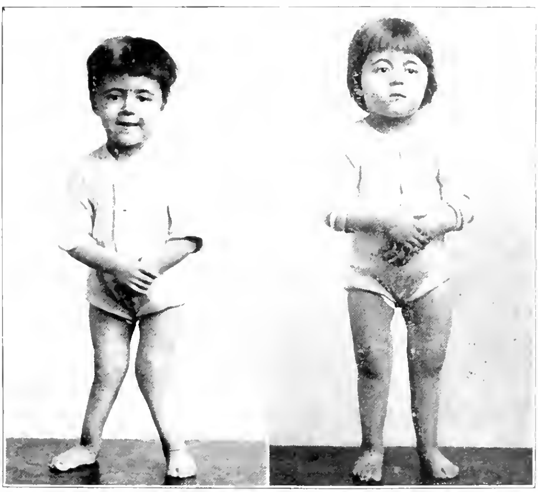

FIG. 6 (case 3)—Boy aged 6 years with pronounced knock knees accompanied by mild anterior bent tibias. This picture was taken to show the dominating deformity, and the anterior bent tibias are shown but poorly.

FIG. 7 (case 3)—Six weeks after rapid bloodless supracondyloid osteoclasis and showing that the correction of the knock-knees has neutralized the anterior bent tibias.

Dr. Robert W. Lovett's[1] rules for the roentgenographic differential diagnosis of the three stages of rickets should never be neglected. In the acute stage, the roentgenogram shows the epiphyses of the tibia clouded and blurred and with the ends of the diaphyses presenting a frayed out appearance. In the subacute stage the shadows begin to clear. With eburnation the normal roentgenographic clearness and regularity of outline returns and not until then should any corrective operation be attempted.

For several years at the Home for Destitute Crippled Children, Chicago, in addition to cleanliness and fresh air we have directed the following diet for our house and out cases.

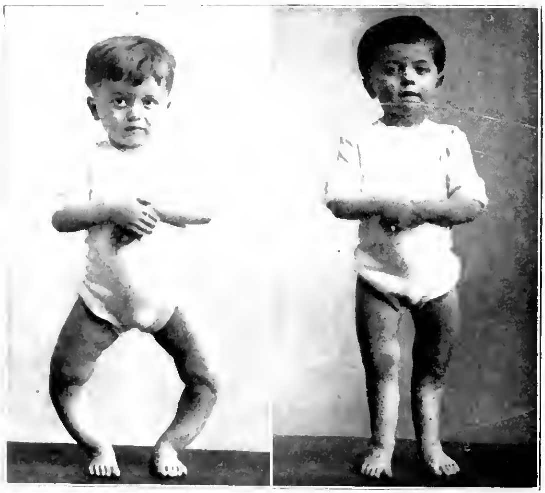

FIG. 8 (case 4)—Boy aged 6 years with pronounced bow-legs accompanying mild anterior bent tibias. This picture was taken to show the dominating deformity and the anterior bent tibias are shown but poorly.

FIG. 9 (case 4)—Six weeks after correction by rapid bloodless osteoclasis of the bow-legs and anterior bent tibias by the one operation.

[1]Lovett, Robert W. Section on Orthopedic Surgery, A. M. A. 1915.

"Rachitic Diet. Orange juice, piece of broiled fat bacon, cereals with cream, rich milk, eggs, scraped or pressed beef juice, bread with much butter, phosphorized cod liver oil, one teaspoon at meals, vegetables. No tea or coffee."

With the cure of rickets the bones usually eburnate quite suddenly and frequently become harder and firmer than normal bone.

Non-unions following osteotomy are of frequent occurrence and are undoubtedly due to the interruption of bone continuity by the chisel and filling of the open space by extraneous materials. I have never had a non-union following osteoclasis and the only one I have known to occur was in the hands of a careful operator and it antedated Lovett's rule for determining eburnation or it would not have happened.

The fear has been expressed that when used to correct deformities close to joints "The osteoclast may slip over the end of the bone and injure the joint."

In twenty years of experience I have never seen a joint endangered by use of the Grattan osteoclast.

In Fig. 1 (case 1) the deformities will be seen to be very close to the lower ends of the tibias and the osteoclases were done as close to the ankle joints as one could desire to do osteotomies. In Fig. 6 (case 3) the supracondyloid osteoclases were done quite close to the condyles. In neither of these cases were the joints in the least danger.

Slow osteoclasis is dangerous and not over eight seconds should be taken for the fracturing of a bone in the osteoclast. A primary consideration in the end-result of any operation is the effect on the mental condition of the patient and the readers attention is called to the dejected look of each patient before operation and the self-confident poise of each cured case.

CONGENITAL SYPHILITIC EPIPHYSITIS IN ADOLESCENCE

BY E. J. GAENSLEN, M. D., F. A. C. S. AND WM. THALHIMER, M. D.,
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This condition is usually described as occurring only during the first months of infancy. Whether congenital syphilitic lesions of any description may occur later in childhood, particularly in adolescence, when there have been no symptoms of syphilis in early life, is regarded by some writers as a contested point. The statement will probably go unchallenged that many cases of bone and joint syphilis are not recognized. Wile of Ann Arbor believes that many cases of syphilis are mistaken for tuberculosis and subjected to operation.

The great difference of opinion as to the frequency of syphilitic bone and joint lesions is in itself an indication that our knowledge of the subject is still very incomplete. Every addition to the literature, therefore, throwing light on the problems involved would appear to be in order. The following case of congenital syphilitic epiphysitis in adolesence is reported because of the difficulty in diagnosis and because of the opportunity afforded for study of the pathology of the lesion.

In July, 1918, a white male age 13, presented himself complaining of pain in the region of the left hip and lameness following a fall while roller-skating. An abstract of the records is as follows: Family and personal history negative except for a mild febrile attack three months previously, with pain in the left lower extremity. Examination showed moderate weakness in muscles of entire left thigh and leg with left foot in slight equinus. There was also moderate atrophy, circumference of thigh and leg being one-half inch less than of normal right. The left leg was one half inch shorter than the right. Both knee and ankle reflexes were absent. These findings were regarded as evidence of a previous mild attack of infantile paralysis. The weakness in the thigh and leg was very decided, more than would be accounted for by the slight atrophy. It gave a distinct impression of paralysis. It must be admitted, however, that while the weakness was perhaps more marked in

the quadriceps extensor and anterior leg muscles, as shown by slight foot drop, it was more generalized than that seen in the usual type of infantile paralysis. The one-half inch shortening in the leg could not well be regarded as the result of so mild and so recent an attack, and was considered a peculiarity rather than an abnormality. The condition was, therefore, regarded as infantile paralysis, and usual measures instituted for restoration of muscle power. Gradual improvement followed without other treatment, but the patient's general condition remained rather below par. No X-rays were taken at this time. One year later the patient returned with pain in the left hip and slight general indisposition. Examination showed tenderness over the left trochanter, slight limitation of motion in flexion, rotation inward and outward, other hip motions remaining normal. Temperature ranged between 99 and 100. Examination otherwise entirely negative. X-rays taken at this time, July 1919, showed the trochanter rather flattened with diffuse areas of rarefaction scattered throughout it and the adjacent portion of the femoral shaft. The epiphyseal line could not be made out, though it was still visible on the sound side. There was slight evidence of periosteal thickening of the shaft below the trochanter. Wassermann test was negative. Blood count was as follows:

Leucocytes	10,000
Erythrocytes	5,070,000
Hemoglogin	85%
Small Lymphocytes	22
Large Lymphocytes	8
Polymorphonuclears	64
Polymorph. Eosinophiles	2
Transitionals	4

Based on clinical and X-ray findings a diagnosis of some low-grade infection still confined to the trochanter was made and operation advised to avoid extension to the joint.

On July 29, 1919, an incision was made over the trochanter, the latter cut through with broad chisel and reflected upward. The cut section of the bone presented a very interesting and unusual appearance.

The cancellous bone appeared to be fairly normal, but scattered throughout the section were large and small irregular areas

of cartilage. The nature of the condition was entirely obscure, but tuberculosis or low-grade pyogenic infection was at once excluded. A liberal section was removed for study, and the cartilaginous areas were removed with curette and the trochanter sutured back in place and wound closed. A large plaster spica was applied. Bacteriological cultures from the bone chips removed were negative.

Wound healing proceeded normally, but patient was rather restless, and sleep was more or less disturbed in spite of adequate fixation. Temperature continued between 99 and 100 for several

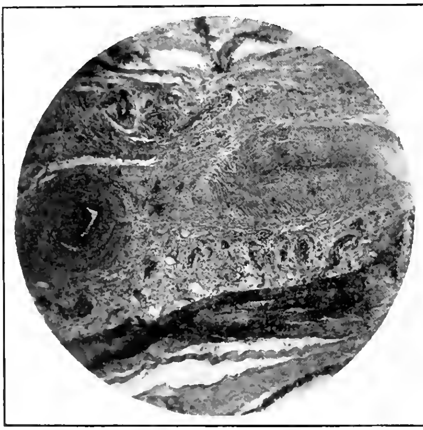

FIG. 1 Thickened Periosteum, showing obliterating endarteritis in two arteries.

weeks, then returned to normal, the patient's general condition improved. The hip motions in the course of several months returned to practically normal. The pathological findings, gross and microscopic, did not help to clear the situation at the time. It was not until a return of previous symptoms about eight months later that further study of the case, especially of the later X-rays, made the diagnosis of syphilis convincing. A second Wassermann test at Columbia Hospital proved to be 4 plus. The previous test was

made outside the Hospital. On further inquiry a history of syphilis in the father several years before patient's birth was obtained, also a history of several miscarriages in the mother.

It is interesting from the standpoint of diagnosis that a report of this case and submission of microscopic slides to two pathologists of national reputation did not help us to make the diagnosis in this case. The points which did assist in finally discovering the nature of the lesion were the periosteal thickening along the shaft of the femur, the recurrence of symptoms in three

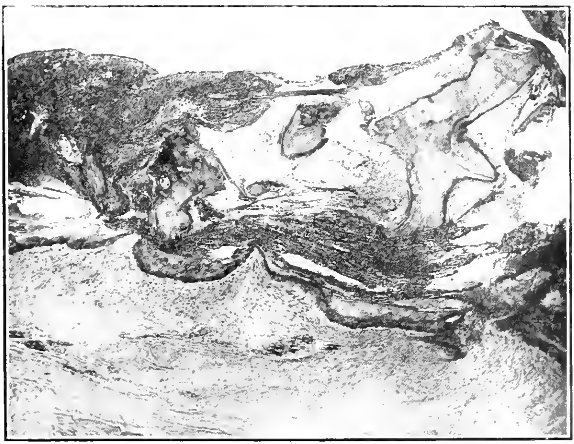

FIG. 2. Thickened Periosteum, and irregular subperiosteal cortical bone.

more or less definite attacks during the 15 months the patient was under observation, the restlessness at night in spite of adequate fixation, and lastly the prompt and complete disappearance of pain on placing patient on anti-syphilitic treatment.

In the light of the later findings in this case there may be a legitimate question as to the correctness in assuming a mild attack of infantile paralysis to explain the weakness and atrophy in thigh and leg as well as the slight foot drop and absent knee reflexes. Parrot has described a syphilitic pseudoparalysis associ-

ated with severe epiphysitis and separation of epiphysis. Whether milder grades of syphilitic epiphysitis may be associated with symptoms simulating paralysis the writers were unable to determine from the literature.

Gross Description

Specimen consists of 7 or 8 large and small pieces of bone which are flattened and have rather smooth surfaces as though removed by a chisel. They vary in size, the largest measuring about .2 by .5 cm. by 2 cm. A few of them are covered by periosteum, and some of them, at one edge, show fairly firm cortical bone, 2 or 3 mm. in thickness. The remainder is cancellous in structure. This cancellous structure, however, is not made up

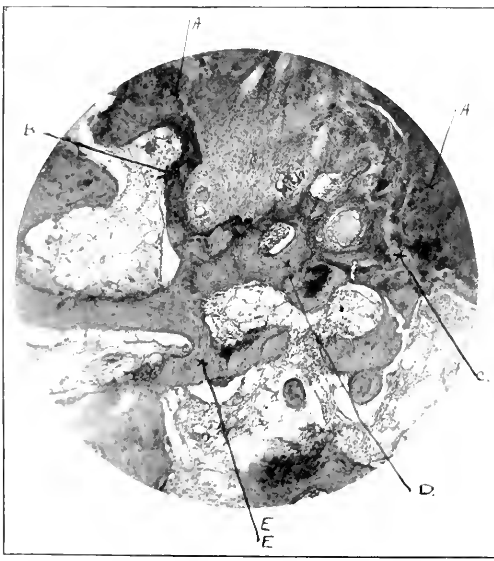

FIG. 3. Riotous admixture of (A) cartilage; (B) excessive degree of calcareous deposit in cartilage; (C) osteogenesis; (D) new formed bone, and (E) old bone.

entirely of bone, and is even more irregular than ordinary cancellous bone. Scattered throughout the cancellous bone is a very irregular architecture of smooth glistening material which has the gross appearance of cartilage. In places this is accumulated into fairly large areas about a centimeter in width and somewhat more than a cm. in length. These accumulations, however, are not isolated, but have ramifying from them strands of similar glistening material, all of which form a most irregular inter-lacing and sponge-like net work, so that there is at least as much, if not more, of this cartilage-like tissue present than there is cancellous bone.

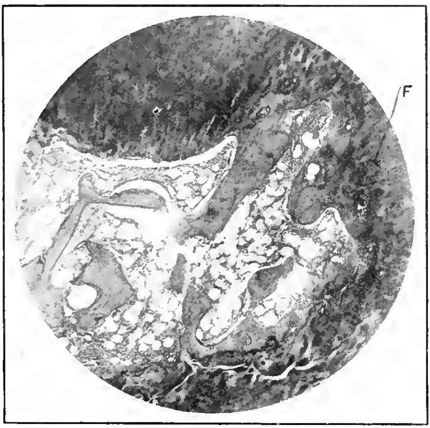

Fig. 4. Riotous admixture of cartilage, and bone at an irregular situation of osteogenesis, with attempt at epiphyseal line formation at (F).

Microscopical Description

Many sections were cut from the various fragments and stained by hemotoxylin and eosin and iron hemotoxylin and eosin. The sections show the various constituents of bone growth at an epiphyseal line, but the various elements are extremely irregularly placed, showing none of the regular arrangement of these tissues, as found in a normal epiphyseal line where bone growth is occurring. The amount of cartilage present is about twice as much as that of

bone. All the cartilage is hyaline in type with all of the characteristics of very young cartilage such as is found in embryonic cartilaginous bones. The cartilage cells are extremely irregular in their distribution, some of them close together, some of them far apart. They are also most irregular in size, varying from very small ones to extremely large ones. All of the cartilaginous areas are in contact with young cancellous bone, and in the midst of some of the large areas of cartilage are what appear to be islands of young, actively growing bone. This appearance of islands may be caused by

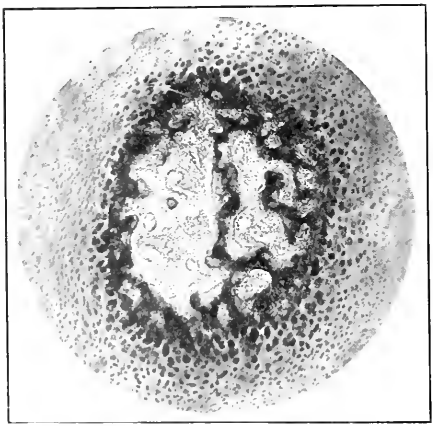

FIG. 5. Island of bone developing in midst of fairly normal cartilage.

strands of growing bone having been cut at right angles. The bony trabeculae are more irregular and tortuous than in normal cancellous bone and are made up entirely of young bone, as determined by the size and staining reaction of the lacunar cells and surrounding bone matrix. The bone, however, does not appear to be all of the same age. In the central parts of the trabeculae there is in some places an imperfect lamellar arrangement, the lacunar cells being smaller and more regular in relationship to one another and the bone matrix has more of the staining reaction of adult bone. Most of the trabeculae, however, show at their periphery a covering of clear-cut and apparently actively growing osteoblasts, some-

times piled up into several layers. Between the osteoblasts and the more completely developed bone is found in most situations extremely young bone with large lacunar cells very irregularly arranged in the matrix, which is somewhat blue staining, in contradistinction to the pink staining of the more adult bone. At many such situations there is present in the adjacent cartilage a greater amount of calcarous deposit than in normal cartilage undergoing ossification. At great numbers of situations, where new bone is being laid down, along the edge of cartilage, or within an area of

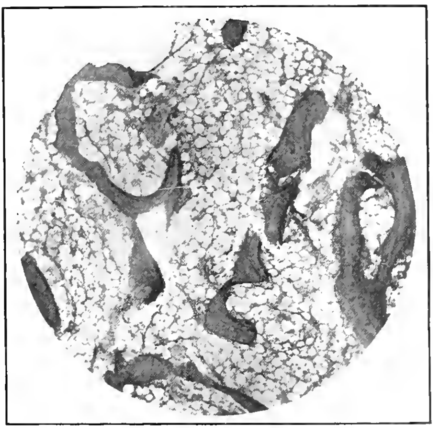

FIG. 6. Slightly atypical cancellous bone with large marrow spaces.

cartilage, there is found the picture of normal transition of cartilage into bone formation. In many places this similarity is so exact that the cartilage cells are found lined up in front of the area of bone growth to exactly duplicate the arrangement of cartilage in an epiphyseal line. The cartilage cells here are arranged in columns vertical to the advancing line of bone growth and are also much larger than normal cartilage cells. The trabeculae of bone in their irregular arrangement circumscribe large and small irregular areas. These areas correspond to marrow spaces and contain all of the usual constituents of true marrow. The structure of this marrow, however, is not the same in all spaces. In some

spaces it is extremely cellular, the cells being those of hematopoietic marrow. In other spaces it is mainly fatty marrow and there are spaces showing all grades of admixture of these two. In some spaces connective tissue stroma is much more prominent than in normal marrow, although in no space is it sufficiently prominent or old to be considered an area of fibrosis. As mentioned above, most of the trabeculae are covered by a layer of cells which in some places are several cells in thickness, made up of typical osteoclasts. At no place is dead bone found, that is, bone with empty lacunar

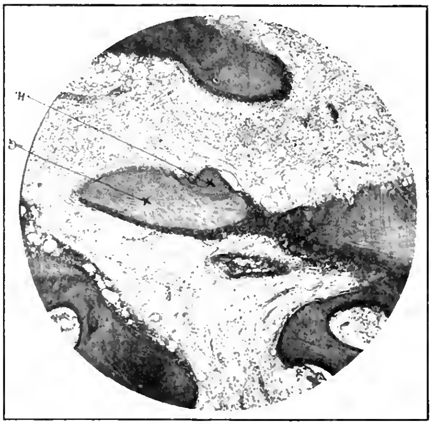

FIG. 7. Trabeculae of bone with well formed (old) bone at center (G); and very young bone at periphery (H).

spaces, and also, at no place is found definite bone absorption by means of osteoclasts, although certain areas are suggestive of this.

One section was made of a fragment covered by periosteum. The periosteum shows a marked degree of thickening and the structure is much denser than normal. Many blood vessels are present and a moderate number of them show a marked thickening of the walls, especially of the intima, amounting in some almost to a completely obliterating endarteritis. The surface in contact with bone is very irregular. The bone which is present here is not a thick layer of dense cortical bone but is made up of irregular narrow pieces of

trabeculae. The bone immediately in contact with the periosteum is young bone but in places shades rather abruptly into older bone. Trabeculae of bone are next found a short distance away from the periosteum, some of which are made up practically entirely of young bone, others of older bone at the center and young bone of the periphery. In the center of some of these trabeculae are found irregular areas of what looks like degenerating bone.

DISCUSSION OF THE PATHOLOGICAL FINDINGS

This lesion in the greater trochanter of the femur we believe to be a manifestation of congenital syphilis. The findings on which we base this opinion are as follows:

1. The predominance of cartilage and the riotous appearance of the process of osteogenesis.

2. The lack of completion of bone formation.

3. The excess of calcium deposit in the cartilage which is in apposition with the areas of bone formation.

4. The obliterating endarteritis in the thickened periosteum.

Stains for spirochetae could not be made because the process of decalcification which was necessary prevented the use of methods for staining spirochetae.

It is believed that the lesion reported corresponds to descriptions of epiphyseal lesions of congenital syphilis given in the literature, such as in Kaufman's Text Book of Special Pathology. The lesions described there were present in the new born and in infants. So far as we know this lesion has never been described in older individuals.

CRITICAL COMMENTS ON A PAPER ENTITLED "ASTRAGALECTOMY IN PARALYTIC FEET"

BY ROYAL WHITMAN, M. D., NEW YORK

To the Editor:

I have read with much interest Dr. Sever's paper entitled, "Removal of the Astragalus in Paralytic Feet†." As I was absent when the paper was presented at the last meeting of The Orthopaedic Association, these remarks may be considered as a belated contribution to the discussion.

Astragalectomy and backward displacement of the foot is first recorded in the report of The Hospital for the Ruptured and Crippled for 1897. Since then more than 1,000 of the operations have been performed at this institution. The opportunity therefore, for observation of late results and for analysis of the factors that determine relative success or failure has been exceptional.

The operation was originally designed for paralytic calcaneus, of advanced degree, often combined with valgus. The transplantation of the peroneal muscles to the tendo Achillis was indicated therefore, to remove a distorting force and to supply a direct pull upon the depressed heel. In this class it is of functional value, but in the less advanced cases in childhood, the transplantation is omitted because it predisposes to inversion of the foot. The latest application of the operation is in the treatment of young children, as soon as the diagnosis of irreparable paralysis of the calf muscle is established, in order to check the rapid and progressive atrophy of the foot, by restoring the resistance necessary for normal locomotion.

The operation is based on pure mechanics and if it is properly performed, the result, in older subjects, whose tissues are stable, is practically assured.

In the treatment of young children, however, supervision is of great importance, particularly the adjustment of the shoe. In

†Dr. J. W. Sever, Boston, Journal of the American Medical Association, Oct. 30, 1920.

The paper referred to is similar to but not the same as that read at the American Orthopedic Association.—Editor.

some cases there is a tendency toward varus, especially if the deformity was originally of this type. It is caused usually by the unbalanced action of the tibialis anticus or posticus, so that transplantation of one or both muscles may be required to supplement the original procedure.

In recent years the operation has been applied to other forms of paralytic deformity, even for equinus, as illustrated by Dr. Sever's report. I have found it most serviceable in reestablishing stability, particularly resistance to dorsal flexion, thus enabling the patient to lock the knee, as an essential to effective transplantation of the biceps, and in the larger class of extreme and extensive paralysis of the lower extremities in which deformities of the feet are the chief cause of the discomforts of brace wearing.

In this broader application, the degree of relative success can be estimated only by its effects in carrying out the particular purpose for which it was undertaken.

Dr. Sever makes one statement with which I most emphatically disagree. "No preoperative condition, so far as deformity is concerned, can determine what the postoperative condition is likely to be."

As has been stated this operation is based on simple mechanics. By removal of the astragalus, one removes the center of lateral motion and lateral instability. By displacing the foot backward, one reduces adverse leverage and implants the malleoli on its basic structure, so that dorsal flexion may be checked by impact of the scaphoid with the tibia. If unbalanced muscles tend to induce deformity, they are transplanted as a supplementary part of the operation.

Movement is controlled except in plantar flexion. Thus the deformity "likely" to occur is equinus and if this is not restrained, the tendency of the dependent foot is toward varus.

In older subjects a moderate degree of equinus, in compensation for a shortened limb is not necessarily undesirable, if a properly balanced shoe, which equalizes pressure on the sole can be provided. But in childhood this tendency should be checked by methodical daily stretching, in which the parents are instructed.

I would here emphasize the point that the "Whitman" operation was designed for paralytic calcaneus, for which in my opinion it is the only effective remedy.

From this standpoint Dr. Sever's material may be examined:

There were 207 operations, of which but 52 were for deformities of the calcaneus type. In 91 cases, the deformity was simple equinus or in combination with lateral deformity, and in 69 of these the Gastrocnemius muscle was in fair or good condition. In 29 the case was one of varus or valgus, and in 15 the foot was flail.

But 80 of the total number of cases appear in the table of "Comparison of preoperative and postoperative deformity."

23 were of the calcaneus type and in 10 of these there was recurrence of the original deformity. Thus in 45% of the cases, failure was complete and it may be ascribed with certainty to insufficient backward displacement of the foot. In 6 of the remainder, varus was present, which implies partial failure. This in my experience is explained either by imperfect operative technique or by unbalanced muscular action indicating transplantation, or by neglect of after care.

Dr. Sever refers to stiff feet, as if stiffness were a characteristic effect of the operation and it appears that in 52 cases there was practical fixation at the ankle joint.

The purpose of the operation, as performed for calcaneus, is to restore lateral stability and to check dorsal flexion at a right angle, but a range of plantar flexion of from 10 to 20 degrees is retained. This is of great advantage since it permits an elevation of the heel in compensation for shortening, and directs the weight forward, thus stimulating the development of the atrophied fore foot.

If there is a tendency toward varus, it is checked by thickening the outer border of the sole and heel of the shoe and by methodical manipulation. If greater restraint of the ankle motion is desired as for flail foot a groove may be cut at the calcaneo cuboid junction in which the denuded malleolus is embedded. But, "stiff ankles" are, in my experience, rare.

I shall not attempt to analyze the miscellaneous cases presented in the paper for obvious reasons. With some of Dr. Severs'

conclusions I can agree, for example that the extent and distribution of the paralysis must necessarily limit the usefulness of a local operation. And, that astragalectomy is rarely indicated for simple varus or valgus, at least, as a primary operation. I should suggest also that one should not apply this operation in the treatment of equinus with an active gastrocnemius muscle, except for the purpose of restraining lateral distortion when it is proposed to utilize plantar flexion to compensate for a shortened limb; for unless it is prevented, the recurrence of equinus is not "likely" but certain.

There is a practical consideration which is of great importance in the more general application of the operation, namely, that older patients whenever possible, discard apparatus irrespective of its aesthetic influence on the gait. For the attainment of this ambition a stable foot is the primary essential.

In the first decade of its history, the operation, in its limited application, was performed almost exclusively by myself, but during the last five years the yearly average has been approximately 100, performed for a variety of conditions, and by many surgeons, including House Officers. The observation of the results of this more general application of the operation shows that they vary in fair proportion with the experience and skill of the operator.

I conclude therefore, that success is determined

1. By the selection of cases, in the sense that the purpose of the operation is clearly defined; whether it be to free the patient from support, or merely to lessen his burden and discomforts.

2. By the understanding of the mechanical principles on which the operation is based, and by exactitude of operative technique in applying them.

3. By appreciation of the type of recurrent deformity to which the character of the paralytic disability predisposes and of the means by which it may be checked or remedied in its inception, which implies of course, efficient after care.

In each of these particulars the treatment at the Children's Hospital, as described by Dr. Sever, as far as one may judge from the report, in the light of one's own experience, leaves much to be desired.

It may be that an operation designed for paralysis of the gastrocnemius is often indicated even when this muscle is active.

as in the 69 cases (33% of the entire number) recorded but such a novel application of the procedure should receive separate analysis. Furthermore, cases in which because of defective technique, the principles of the operation have not been applied should be excluded from consideration altogether. From the scientific standpoint the chief value of such investigations is to bring to light errors of omission and commission that may be avoided in the future by those who made them. I cannot agree therefore with Dr. Sever, that "we may well rest content with these results until similar figures and results are available for comparison." How can the surgeons of The Children's Hospital rest content when their records state that in 15 of the 54 cases in which a note is made, the backward displacement of the foot was insufficient, and when the statistics indicate clearly that in the treatment of calcaneus this percentage of admitted error was far exceeded?

As the originator of this operation, and indirectly responsible therefore, for the results, I feel that it is my duty to offer this, which I trust may be considered constructive criticism.

THE TREATMENT OF FRACTURES

BY H. WINNETT ORR, M. D., F. A. C. S., LINCOLN, NEBRASKA

Read before the Annual Meeting American Orthopedic Association, Toronto, Canada.

Our methods for the treatment of fractures show a marked recent tendency toward further demoralization by the popularization of methods which in reality or by implication shorten the period or impair the efficiency of immobilization.

In the time of Mr. Abernethy, a hundred years ago, fractures of the femur, especially of the neck, were considered to be treated in a satisfactory manner if the patient were kept upon his injured side in a feather-bed. If non-union followed, Mr. Abernethy said, "The people will say we did everything we possibly could have done, and that it was the nature of the case never to get well."

Since that time many expedients of treatment and various kinds of apparatus have been placed before the profession for the treatment of leg and femur fractures. It is in an effort to arrive at some conclusions regarding the value of these methods and devices that the following paper is presented.

In a statistical table of fractures in the London hospitals for thirty five years femur and leg fractures constituted more than half of all hospital fracture cases. In the American Text Book of Surgery published in 1894, the statement is made that the reduction of fractures "should be made as completely and as promptly as circumstances will permit, having regard to the condition of the patient and of the limb. If there are severe associated injuries and the shock is great, it is well to wait for reaction, and meanwhile to immobilize the parts in partial reduction with simple dressings; if the limb is greatly swollen it may be impossible to restore it to its full length without causing dangerous pressure. An anaesthetic may be required to overcome the opposition of the muscles; and in the case of a fracture near to or involving a joint, anesthesia is doubly valuable, both to recognize the details of the fracture and to facilitate the complete and accurate readjustment of the parts."

For dressings, the above text-book objects to any circular bandages being employed. It suggests wooden splints for lateral support and recommends fracture boxes, Volkman's splint, wire gauze, moulded splints, plaster of Paris, Buck's extension, Smith's anterior splint, Hodgen's splint, and various modifications of these

devices. Under the heading of delayed or non-union this text book speaks as follows:

"A gratifying number of successes in fractures of the leg and thigh have been obtained by the use of orthopedic splints. In a number of cases of delayed union of the leg, union has gradually become complete while the patient was using the limb under the protection of a suitable splint; it is thought that the slight irritation caused by bearing the weight upon the limb favors ossification."

Bone transplantation and metal plates had not been introduced and amputation was suggested to rid the patient of a useless extremity in which non-union had occurred.

In "Surgical Diseases of Children" by Samuel W. Kelly, 1914, fracture of the shaft of the femur is treated by "Bandaging the thighs together with a folded towel between the knees or straight strips of binder's board applied around the limb and retained by adhesive straps and a bandage." It is said, also, that "perfect results are also obtained by simple straight splints from the waist to the ankle."

While it is true that such perfect results have been obtained, one knows that many of the deformities in legs and thighs of older children are due to just such careless methods in the treatment of fracture in infants and young children. Dr. Kelly, in this book, in one sentence, says that, "Binder's board or a whittled wooden splint may be used in fracture of the leg;' and then in the next sentence that "Ready-made splints seldom fit." The latter teaching is excellent.

One of the points which it is desired to emphasize in this paper is that in general, similar methods should be used for fractures in children as in adults. At any rate the same principles must be observed.

In one of the more recent works, "Medical and Surgical Therapy" edited by Sir Alfred Keogh and published by D. Appleton and Co. there are extensive articles on fractures presumed to record our conclusions from the fracture surgery of the war. This volume, which will probably be extensively used represents practically only the conclusions of the French.

Personally the writer of this paper finds much in the writings of Dr. Leriche with which to agree. Unfortunately, however, the

plaster of Paris technique—almost his sole resort—will be understood by but few and will confuse many.

There is one excellent feature in the work of Dr. Leriche. He adopts plaster of Paris and discusses no other forms of mechanical treatment or apparatus. Mechanical principles demanding restoration of normal relationships and immobilization are complied with but only by the use of plaster of Paris as a fixative.

In observing patients in which attempts to secure similar results have been made with the ordinary splints, especially the ready-made splints, with either weight and pully traction or no traction at all, one must conclude that only those fairly accurate in the use of plaster of Paris should attempt to follow the teachings of Leriche.

A recent text book evincing unusual care is that of Warbasse, published by Saunders and Co. The first of the three volumes is devoted largely to diseases of bones and joints. The article on fractures remarks by way of preface, "The immediate treatment of fractures is based upon two fundamental principles—the correction of deformity and the holding of the fragments in normal apposition until they grow together."

Warbasse expands in detail upon the methods for immediate reduction and fixation. He says that plaster of Paris is the most valuable of the materials used for splinting. There is a careful description of plaster of Paris technique (pp. 477-478) and much could be gained by combining his work with that of Leriche for application to the treatment of all fractures. Unfortunately Warbasse falls into the common error of proceeding directly from this most useful of all methods to various others less easy to understand and more difficult to use. Various wire frame and suspension devices are described going as far back as to the time of Volkman.

The writer of this paper is willing to go so far as to say that as a matter of practice it is quite wrong to teach any longer the methods of treatment for leg and thigh fractures as given by Warbasse on pages 486-7, 490, 491, -2, -4, -9, and 500.

From hundreds of observations upon these and various other modifications of such treatment it has been emphatically shown that neither immobilization nor satisfactory traction can regularly be obtained by these methods. To copy these methods from one

text book to another as has been done for a number of years is to carry into the whole treatment of fractures an amount of confusion which leads not only to a lack of standard methods of treatment but to a failure to secure anything like a uniformly high standard in the way of results.

The Thomas hip splint which should be used in nearly all fractures of the leg and femur is not described in Warbasse's book at all. The Thomas splint described by him on page 586 is a posterior hip splint which is not a traction splint at all and one which applies to joint conditions or to the late treatment of fractures only.

Without unduly prolonging this paper by further argument, the writer wishes to put down these following conclusions which he believes to be fully justified by the military hospital experience of the recent war.

First, There are two agencies of major importance in the treatment of fracture of the femur and the leg. These are the Thomas splint and plaster of Paris.

Second, The less the Thomas splint is modified the more efficient it is.

Third, For fracture of the neck of the femur, as shown by Dr. Whitman, and for fracture of the leg below the knee, either open or closed, plaster of Paris is usually indicated.

. *Fourth*, For fracture of the shaft of the femur the Thomas traction splint has shown itself to be far more useful both as an emergency splint and a splint for continuous treatment than any or all other mechanical devices heretofore recommended for the purpose.

Fifth, Skeletal traction for fracture at the extreme lower end of either the femur or leg is a justifiable addition to the Thomas splint.

Sixth, The Balkan frame and, in a few instances the Hodgen splint may be applied in extensive compound injuries to the thigh.

Seventh, Mole-skin plaster or adhesive glue must be used for traction. This is better because it is intrinsic in the Thomas splint. In addition to this, elevation of the foot of the bed with the splint anchored at the lower end contributes to the traction and simplifies the wearing of the ring splint.

Eighth, Elimination of Buck's extension, Hodgen's splint, weight and pulley traction, the Ruth Maxwell method, Volkman's

sliding splint, the Liston splint, and similar and related methods from our text books would hasten the day of general adoption of the Thomas splint and tend toward the rapid improvement in efficiency of treatment and the character of results in fracture of the thigh and leg.

The attempt to provide numerous methods of splinting results in the present state of things, that it is the rare surgeon who is really proficient in the use of one. From having seen thousands of splinted fractures by many surgeons I can say that real immobilization of a fracture in a splint is seen only occasionally. And it is in this connection that I desire to make the principal point of my paper.

Stiff joints and limited motion have regularly been blamed upon too thorough and too prolonged immobilization. If this were criticism of a method we might allow it to pass. It is however, in fact, an attempt to contradict the fundamental truth that rest is essential to healing. My own opinion is that the stiffness, excess callus, adhesions and ankylosis are all due to failure to adequately immobilize. Ideal immobilization from the beginning, would, I believe, regularly give us healing of joint injuries with a minimum of joint damage and with therefore, a minimum of ankylosis.

Bony ankylosis of a joint is of course the result of joint pathology and quite as certainly any really damaged joint is further damaged by irritative movement before healing has occurred. Careful distinction must therefore, be made between an inflammatory joint condition without destruction of the articular surface in which a joint may be moved and all other joint conditions in which with a different pathology a joint may be kept moving for a time but only at the expense of further injury and more certain subsequent bony fixation.

I desire to comment finally upon the mobile joints exhibited so proudly as a result of early movement in fractures near the knee. It is my opinion that such knees treated by the method of Major Pearson and others move so well not because of early motion but in spite of it. The secret of the success of the method I believe, lies in the excellent splinting which secures, even with a moving knee, such good position and such perfect fixation of the fracture fragments. Certainly one sees regularly serious deformities and complete ankylosis in patients in whom with persistent efforts at knee motion the fracture itself has not been controlled.

News Notes

The Orthopædic hospital under construction at Gastonia, North Carolina, will be completed and ready for occupancy early in 1921.

It is announced that Grove Park Inn at Asheville, North Carolina, will henceforth devote all profits to the establishment and maintenance of a hospital school for crippled children.

Drs. Theodore C. Lyster, Eugene R. Lewis and Isaac H. Jones announce their offices at 1920 Orange Street, near Westlake Los Angeles.

Dr. John W. O'Meara is in practice in orthopædic surgery at 3 Linden Street, Worcester, Mass.

At a meeting held December 3, 1920, the Pittsburgh Orthopædic Club was inaugurated with the following officers: Dr. Stewart L. McCurdy, President; Dr. David Silver, Vice President; Dr. Eben W. Fiske, Secretary. Monthly meetings will be held.

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Current Orthopaedic Literature

Late Rickets and its Relation to Chronic Diseases (Genu valgum and varum, Coxa valga and vara Osteochondritis coxae, Schlatter's disease, Pes plano-valgus and kyphoscoliosis). By A. Fromme, *Bruns Beitraege z. klin. Chirurgie.* Bd 118. Heft 3. Seite 493. 1920.

The article is the result of investigation upon 103 cases in the Surgical clinic of the Univ. of Goettingen. The chief complaint was pain, especially in the knees and feet. Among the objective findings were predominant: Hypertrophy of the epiphyseal junction and flatfoot. The gait was unsteady apparently the result of muscular weakness. Tenderness on pressure upon the bones and in several instances metaphyseal enlargement which suggested Barlow's disease. The X-ray always revealed typical rachitic changes in the epiphysis and presented at times spontaneous fractures.

The author explains the development of these deformities on the basis of a continuous trauma acting upon the zone of growth, i. e. the epiphysis. Genu valgum, Coxa vara and valga have developed from the simultaneous action of body weight and muscle pull; osteochondritis coxae or Perthes disease results from weight bearing upon the newly formed bone under the articular cartilage; Schlatter's disease is the sequence of pull of the Quadriceps upon the tibial tubercle. In all cases the rachitic changes have altered the inherent strength of bone and epiphysis. Late rachitis is much more prevalent than commonly supposed. Therapeutically is advised a careful bloodless reduction of the deformity and general treatment.—I. *Gottlieb, San Francisco, Calif.*

Some Difficulties in the Diagnosis of Osteosarcoma. By Robt. B. Cofield, M. D., Cincinnati. *Jour. A. M. A.*, Vol. 75, No. 19, Nov. 6, 1920.

As osteosarcoma's primary origin is in the medulla or the periosteum of bone, as it is not confined to any particular age in life, and as it not infrequently runs an irregular clinical course on account of the wide variation in its histological elements, its early recognization is extremely difficult. The fact that a deferred diagnosis not infrequently means the sacrifice of the patient's life, while a mistaken diagnosis may result in the needless loss of the patient's limb, brings to us the realization of the importance of a careful study of this problem.

Since there are no pathognomonic symptoms or definite serologic reactions whereby we can recognize the early appearance of primary osteosarcoma, we are compelled to rely for a diagnosis on: (1) the clinical data; (2) roentgen-ray examinations, and (3) exploratory operation with macroscopic and microscopic examination of the pathological material.

The clinical course of osteosarcoma varies according to its origin and degree of malignancy, and whether it is of the medullary or periosteal variety. Medullary sarcoma appears in the long bones usually has its origin in the region of the metaphysis, and soon takes on a rapid destructive effect, invading the shaft and breaking thru the cortex, where it is prone to involve the surrounding tissues; the epiphyseal and joint cartilages are the most resistant barriers to its invasion. Pain, of a severe, boring character, is often the first indication of its presence; and on account of its proximity to the joint and the accompanying effusion which may appear in the articulation, the condition is often mistaken at first for an arthritis. Since the pain is neither increased nor relieved by fixation, the arthritis involvement can usually be ruled out. An irregular temperature with elevation to 99 or 100 F. occurs, especially in the rapid growing form. A leukocytosis may be present to some extent and some authorities believe that an eosinophilia is a sign of value in the diagnosis of this variety. The Bence-Jones protein reaction in the urine may be present. Since metastasis is disseminated thru the blood stream, involvement of the lymphatic glands does not occur until late in the disease, with the possible exception of melanotic sarcoma. Metastatic deposits in the lungs may occur producing an irritating cough and the characteristic oval sarcomatous areas depicted in the roentgenogram. Decalcifacation of bone at the seat of the lesion may result in a spontaneous fracture. The rapid growth of the neoplasm and the infiltration of the surrounding tissues cause pressure on the deep veins, resulting in an engorgement of the venous circulation in the overlying skin. Cachexia soon develops, the patient rapidly looses weight and life is rarely prolonged longer than two years, in inoperable cases.

Sarcoma of the spine is usually of the medullary variety and most frequently involves first the bodies of the vertebrae. The clinical characteristics are similar to those occurring elsewhere in the osseous system, with the exception that here we soon encounter the formation of a gibbus from the crushing of the vertebral bodies by the superincumbent weight, and the rapid development of a paraplegia from the destructive invasion of the spinal cord. The examination of the spinal fluid may give a positive reaction in Lange's gold test and the yellow color of the fluid may suggest the presence of a malignancy.

The clinical picture of periosteal sarcoma varies but slightly from the myelogenous variety. The pain which the patient experiences is not of the severe boring character, but more of an ache; the tumor mass, being external to the shaft of the bone, is more easily recognized, and the early invasion of the continuous joint is more likely to occur.

The roentgen-ray picture of central sarcoma of the long bones is one of irregular destruction, with little or no tendency toward new bone formation until the periosteum is involved or broken thru. The lesion is usually confined to one area, although multiple lesions are occasionally observed. Medullary sarcoma in the beginning may be confused with myeloma, cyst and osteomyelitis. Since they frequently have the same point of origin and are more or less destructive in character, it may require repeated roentgen-ray examinations to differentiate these conditions. In myeloma, the globular outline of the tumor is maintained during its expansion; the swelling shows little or no tendency to extend along the shaft or break thru its capsule and invade the sur-

rounding tissues and, when completely removed does not recur or produce metastisis; myeloma was formerly classified as a nonmalignant giant cell sarcoma and is probably the same condition described by Barrie under the title "chronic hemorrhagic osteomyelitis." In cysts, the cell wall is usually sharply outlined and clearly defined, and shows no tendency toward rapid expansion and invasion.

In suppurative osteomyelitis the roentgen-ray findings are often not definite enough in the beginning to make a diagnosis; but as the disease progresses, the inflammatory redness of the skin appearing over the rapidly growing tumor would suggest a pus infection rather than malignancy.

Sarcoma involving the spine may portray an expansile tumor of the vertebrae simulating a circumscribed abscess when viewed in the anteroposterior position; and at the same time a lateral view may reveal the crushing of the vertebral bodies, as seen in Pott's disease. In other cases the extensive destructions of the vertebrae accompanied by more or less hyperplasia of bone, may resemble syphilitic spondylitis. The severe pain, which is not relieved by fixation, the rapid invasion of the surrounding tissues and the early involvement of the spinal cord, with a resulting paraplegia, strongly suggest malignancy.

The roentgen-ray picture of periosteal sarcoma is more distinctive in character, the new bone formation showing a trabeculation or spiculation at right angles with the shaft of the bone and presenting a smoky appearance. Early in its course it may be mistaken for osteoma, osteochondroma and myositis ossificans. Osteoma and exostoses are readily recognized, as they are conical or pedunculated, and their sharp outline is continuous with the bone from which they arise. Osteochondroma, when growing from the epiphysis laterally, gives a rather typical appearance; when of central origin it is more confusing. Either form may at any time take on the characteristics of malignancy, indicated by rapid growth and destruction of the enveloping capsule.

Myositis ossificans and ossifying hematoma, the latter occurring in subperiosteal hemorrhage from injury or scurvy, show a definite bony border due to the deposit of calcium salts, and the bone is laid down parallel to the shaft rather than perpendicular, as seen in periosteal sarcoma.

Clinical observations and roentgen-ray studies should not be continued over too long a time. When the clinical data and roentgen-ray examinations are not sufficiently distinctive to make a diagnosis an exploratory incision is justified. If the presence of malignancy is established, operative measures, unless they are contraindicated, should be carried out at once.—*Leo C. Donnelly, Detroit.*

REMOVAL OF THE ASTRAGULUS IN PARALYTIC FEET. RESULTS IN TWO HUNDRED AND SEVENTEEN CASES. By J. W. Sever, M. D., Boston. *Jour. A. M. A.*, Vol. 75, No. 18, Oct. 30, 1920.

It seems wise and of distinct value to present end-results from clinics or individual operators, regardless of the nature of the results. New procedures often lead to a stampede of operating by the advocated method, without knowl-

edge of end-results, and even old methods are often perpetuated indefinitely until one takes the trouble to see the end-results of such procedures, two, three, or five years later.

The main object of this operation is to restore the symmetry and stability of the foot following paralytic distortions or relaxations. This report covers 195 cases. The operation has been performed on 217 feet in these cases by eight different surgeons, on feet varying from those completely paralyzed to those in which only one muscle was weak or gone. The object in all cases was to restore either symmetry or stability. It has failed to do this in many cases.

It seemed a matter of interest and importance for any adequate study to determine the muscle power existing in these feet before operation.

Under the classification good to fair are those feet in which muscles were: (a) normal; (b) good: when the muscle was strong enough to overcome gravity and some resistance, but was not quite of normal strength; (c) fair: when the muscle was able to overcome gravity and could perform part of the normal movement; (d) poor: when slight movement could be accomplished but gravity could not be overcome, and (e) gone: totally paralyzed; no perceptible contraction.

The persistence of power in the toe flexor group, with weakness or complete loss of power in the other groups, especially the toe extensors and the peroneals, leads in many cases to a postoperative varus associated with equinus of greater degree than was planned for at the time of operation. This deformity is liable to increase and result in a foot no better than before, and in many cases worse than previous to operation. In the analysis of a large series of cases by Lovett, it has been shown that of all the foot muscles, the toe flexors are the least often involved and the least often totally paralyzed. The posterior tibial has played very little part in this deformity, for in connection with the anterior tibial, it has been the most frequently paralyzed, or affected to the point at which it could not function effectually. Even adequate backward displacement of the foot may lead to later troublesome varus with persistent toe flexion. It would be better to divide them at the time of operation, for they act in the same way as they do in congenital club-foot, and tend constantly to increase the varus and equinus deformity.

A foot, which, even if unstable at the ankle, allows weight bearing with the sole flat on the ground is, other things being equal, better than a foot with a more or less stiff ankle, with the forefoot in equinovarus, and weight bearing restricted to the ball of the foot or its outer border.

In a number of cases, transplantation of tendons has been made, namely, the peroneals have been carried forward and inserted into the mid-dorsum of the foot. In others, the peroneals have been divided and inserted into the os calcis after Whitman's method. The author sees no especial reason why they were disturbed at all. If the operation was devised to correct a hollow foot, in this series it has in many times failed to do so.

Originally devised as a practical operation for a calcaneovalgus deformity to insure stability, the operation has of late years been used more and more to insure lateral stability of the foot for all paralytic conditions. This is alright perhaps so far as the foot goes, but there are other considerations to be taken into account in walking and weight bearing besides the foot alone. Rarely

does one see in a given case, supposedly in need of astragalectomy, the foot and lower leg alone affected. Many times the trunk, abdominal, gluteal and thigh muscles are paralyzed in a greater or less degree, all, of course, affecting the gait and function. Many times the feet and ankles are the least factors, and not at all the principal elements in the lack of ability to walk.

An astragalectomy for a simple varus or valgus represented by a moderate lateral instability is not indicated. The indication is quite in the other direction in a flail foot, or a foot with only one muscle group left, in which there is persistent deformity in weight bearing, and inability to get the sole of the foot to the ground in weight bearing. With a complete flail leg and foot, the question is not at all clear that an increase shortening as a result of the removal of the astragalus, and a stiff ankle, are going to make very much actual difference in function, as a brace will always have to be worn.

On the basis of a limp alone, the major part of the limp may not be due to the foot condition, as may be noted in the study of any series of cases, but may be due to weakness of any of the leg, hip or abdominal muscles. Following astragalectomies, the limp is practically no better except in those cases who had such good muscle power before operation that the operation should never have been performed, and where the ankle motion is nearly as good as that seen in a normal foot. Loss of ankle motion as expressed in an inability to plantar flex, either due to paralysis of the gastrocnemius, or as a result of an operative procedure, gives the same end-results so far as a limp goes.

An analysis of the individual deformities before operation and after operation shows that any type of variation is possible and that no preoperative condition, so far as the deformity goes can determine what the postoperative one is likely to be.

As a result of this analysis of these cases, I feel that an astragalectomy is not an operation to be advised for any foot showing lateral instability as a result of the paralysis of one muscle group alone. The lateral instability of the ankle may be corrected, but more subsequent deformity may develop. It is as good an operation as any in feet that are flail, or those that have only one muscle group left. In the presence of toe flexors, varus is likely to develop later and lead to a bad weight-bearing position.

The best results were in feet that had good muscle power before operation, and where after operation there was good motion between the tibia and the os calcis, and good weight-bearing position of the foot. In the latter cases, the author beileves that it never should have been performed. It is not an operation that will cure a limp or even improve one as a rule.

It is not an operation to be advised lightly or invariably for foot deformities, but should be performed on older children in selected cases.—*Leo C. Donnelly, Detroit.*

Rib Grafting Operations for the Repair of Bone Defects and Their End-Results at Letterman General Hospital. L. Eloesser. *Arch. Surg.*, 1920, lxxii, 428.

In bone grafting operations, the author selects the ribs as furnishing the best material for bone transplants. It was believed than a thin, highly viable, vascular graft, with soft cortex and a large amount of cancellous tissue produces

better results than a bone with thick, dense cortex and little or no cancellous tissue. Absorption of osseous tissue and deposits of permanent bone take place more rapidly in such a graft, thus permitting an earlier return of function to the limb.

Gallie states that the processes of absorption outstrip those of replacement and therefore cancellous bone, such as rib. should not be used when the graft is to be placed under strain or when the gap to be bridged is wide and rapid absorption is not desired.

The author's series seems to show that the very tardiness with which massive grafts are absorbed is a distinct advantage inasmuch as a thin, frail graft may be absorbed before the osteoblasts are prepared to lay their bony deposits on it.

The practical advantages of the rib graft consist in the unlimited supply, its easy accessibility, its comparative tubular strength, its viability, and the short postoperative stay in bed.

The technic of rib-grafting is not difficult being essentially the same as for any other graft. The front part of the fifth or sixth ribs is usually selected, as it is straightest. The rib is removed with its periosteum without opening the pleura, which although not dangerous, is best avoided. The rib is carefully dissected away from the muscles and pleura for one or two inches; it can then be snipped off by a curbed rib shears. The cut end is retracted outwards and the intercostal muscular attachment dissected as far back as necessary. A hole is then drilled through each end of the excised rib and the graft split longitudinally with an osteotome or stout knife. Kangaroo tendons are threaded through the holes in the graft and through the previously drilled holes in the ends of the fractures; they are then threaded around the entire bone with a ligature carrier tied securely. The split portions of the graft form a trough in which lie the ends of the fractured bone. The periosteum is sutured, the soft parts brought together, the skin closed, and the extremity encased in plaster.

Variations in the application of the graft to different types of cases will readily suggest themselves. Fixation should be used for from ten to twelve weeks as Gallie as shown that two months is the average time at which absorption is complete.

In reporting his end-results, the author considers those operations successful in which firm union has taken place according to both x-ray and clinical evidence. The series includes twenty-two cases. Operations on seven of ten patients with radial defects were successes and three were partial failures. One ulnar defect, partially successful, refractured at operation. There were five patients with defects of both radius and ulna, one partial and four complete successes. All operations for humeral defects were failures. One defect of the tibia and jaw each was successfully repaired. Eleven patients had more or less suppuration following operation. Refracture occurred in seven, or almost one-third of the twenty-two cases. The bone graft always broke in the middle, the end being united to the matrix bone.

The author concludes that the rib-grafting is a feasible procedure and survives very well even in the presence of suppuration. The grafts absorb rapidly and hypertrophy slowly. They are inferior to tibial grafts in the repair of large defects and in the ability to bear strain. Of twenty-two cases, three were

failures, thirteen were successes, and six were partial successes.—*A. C. Johnson, Rochester, Minnesota.*

TREATMENT OF COMMINUTED FRACTURES OF THE MANDIBLE. By H. A. Potts, M. D., Chicago. *Jour. A. M. A.*, Vol. 75, No. 18, Oct. 30, 1920.

The general plan of treatment of mandibular fractures must be kept in mind, namely, the reduction of all viable fragments and the retention of all teeth, if they are not detrimental to repair. Teeth should be kept in their normal occlusion and all bone fragments and osteogenic tissues in as nearly normal position as possible. Efficient drainage, as indicated either before or after reduction and retention, is all important, as these cases are almost invariably infected.

If the patient has been seen early and presents an open wound, all dead soft tissues and detached bone fragments and foreign bodies should be removed. Small attached fragments may be temporarily wired to larger ones or to a splint used to immobilize them. Circumferential wiring may be employed to draw into place and retain larger fragments, the wire being passed around the bone and twisted over a splint.

When the bone is badly comminuted, the parts may be molded and held more or less satisfactorily in place by modeling composition below the chin, at least until, by plastic exudate, the parts become a little more stable, when they may be better retained by another appliance.

It is desirable when teeth and much bone have been lost, to hold the remaining periosteum in its normal relationship as, in many cases, by regeneration of bone in its proper place, bone grafting may be facilitated or in some cases avoided. Fragments of teeth, fillings and roots should be sought for in the soft tissues, as many times they have been found quite distant from the site of fracture. Tooth roots exposed in the line of fracture should be removed, although at times they may be utilized temporarily for the retention of a fragment. Their retention may be at the expense of union, as they are frequently the sole cause of nonunion.

Retarded union is often due to the presence of a devitalized tooth whose root, even though it may be some distance from the line of fracture, exhibits a restraining influence due, no doubt to bacteria or toxins retained within the canal; and in such a case the roentgenograms may be negative.

At times we may be justified in retaining a large sequestrum involving the diameter cf the bone, provided the wound is draining freely and it is frequently irrigated in order that the periosteum may mold the new bone supplying the lost part.

Potassium permanganate, 1:1,000 or even stronger, is one of the best medicaments to control the fetid cdor, which is very marked in most of these cases. The use of the douche-can irrigator three or four times daily is essential, and the patient should have a supply of his own which he should use every hour as a mouth wash.

In general, each case should be considered from three standpoints: (1) the restoration of bony jaw; (2) the restoration of mastication; (3) the cosmetic result.—*Leo C. Donnelly, Detroit.*

BONE AND JOINT TUBERCULOSIS. By Dr. Scharff. *Archiv. f. Orthopaed. und Unfall-Chirurgie.* XVIII Band. ½ Heft. 1920 Seite. 282.

The treatment of bone and joint tuberculosis has in the last few years undergone various changes. The purely operative procedures, especially the joint resection, has been more and more abolished. Of all operations Albee's has survived the test and has proven useful and efficient in the hands of most orthopedic surgeons. Except the latter, no other extensive surgical procedures are practised; only puncture of the tuberculous abscesses and suppurating joints followed by injections of 5-10% Iodoformglyzerin or Iodoform-Humanol (humanfat) or Iodin-Iodoformglycerin is still advocated.

The conservative treatment consisting of immobilisation of the affected extremity in plaster of Paris splint or jacket for spinal tuberculosis is the therapy at present in vogue. Natural and artificial sunlight, and the specific tuberculins are extensively used and advocated by the various authorities of this subject, in addition to the rest of the diseased parts. Of the specific treatment is mentioned the partial antigen of Much-Deyke and the Friedmann's tuberculin. The latter has gained many adherents who have reported favorable results particularly in the beginning stages of bone and joint tuberculosis. Much-Deyke partial antigen is used therapeutically and diagnostically; it is recommended particularly for the purpose of diagnosis in doubtful cases.—A. *Gottlieb, San Francisco, Calif.*

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JOINT RANGE.

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PITTSBURG.

In the movement of an extremity the two most important factors involved are the power or amount of force present and the amplitude or range of motion; the former being indicative of the amount of function present in the muscles crossing the joint and the latter of the amount of motion between the joint surfaces.

It is desirable in the progress of a given case of joint disability, to be able to measure, in some simple and practical manner, one or both of these factors. To measure power, or the amount of force present in muscles crossing a joint, the methods devised by Drs. Lovett and Martin (1.) are probably the soundest. While conceived, primarily, for use in measuring muscle function in poliomyelitis, experience has shown that the principles involved hold in any case of muscular disability.

It is not within the province of this article to detail the methods of measuring power. We are concerned only with the measurement of the amplitude or range of motion, and the reader is urged, for the sake of clarity of thought, not to confuse in his mind the two factors. In the former we speak in terms of pounds moved under fixed conditions, while in the latter we speak in terms of degrees of a circle traversed by the distal constituant member of a joint.

To take the measurement of the range of motion, a special instrument of some sort is required and many have been devised, among which may be mentioned the following:

The Arthro-Dyanamoter of C. F. Sonntag, consists of a frame work to carry the member under observation, a series

of pulleys and weights for measuring power, provision being made for measuring range of motion on a protractor scale appropriately arranged and fastened in relation to the joint. It is quite large and there are numerous attachments. Fortesque Fox has designed a series of five instruments, four of which he calls respectively the Fleximeter for the wrist and fingers, for the ankle, for the knee and for the elbow. Those for the wrist, fingers and ankle may be used by being laid on the back of the joint to be measured, while those for the knee and elbow must be strapped on. The essential principal of these instruments is an indicating arm acting in relation to and registering against a protractor scale. In addition to the four instruments mentioned he has also devised what he calls a Torsionmeter to measure pronation and supination. This instrument consists of a base board to which is attached, at its lower end a protractor scale upright, and at right angles to the axis of the forearm when it is strapped in position for observation. Attached at the axis of the scale is a handle which actuates the indicating finger against the scale as the hand is turned. It is one of the best instruments for measuring supination and pronation, but it is unfortunate that it has been so named. We should not think of supination and pronation as being essentially torsion movements. This will be made clear later when speaking of the movements of particular joints. Dr. H. C. Gifford (2) has designed a set of instruments for measuring the range of joint movements; there are four instruments in the set and the principal of the protractor is used in all. In addition to the above, an instrument designed by W. Wilbraham Falconer has recently appeared on the market. It is a device consisting of a circular metal box carrying a protractor scale on the front against which registers a pointer actuated by a counter weight inside the metal box. It is to be strapped to the member to be measured and the range of motion read as the part is elevated.

The instruments mentioned above are only a few of the many evolved for measuring joint range. They all have some disadvantage. Either they are too large and complicated to be carried about or their construction is such that they are not adaptable to all joints. The original instrument was a protractor modified so that its use on the extremities was

facilitated. It consisted essentially of two arms; to the end of one was attached a protractor scale, while one end of the other arm was shaped to a pointer; these arms were connected at the axis of the scale so that the pointer registered against the scale. For general utility this type of instrument fills all requirements. With only a moderate amount of care in placing the instrument and taking the reading, as great accuracy is attained as with a much more complicated apparatus. In addition it may be used in other ways than measuring joint range, as for example measuring the amount of angular deformity of a fracture on the X-ray plate which is often a very important consideration in the treatment, particularly in fracture of the neck of the femur. It might also be mentioned, in passing, that such an instrument is occasionally very useful in brace designing to establish on the drawing definite angles.

In order to provide an instrument for general use that might be carried in the pocket and thus be always available just as is the pocket tape, the writer suggests an instrument made of metal and of the protractor type with the arms jointed to fold on themselves; this reduces the length of the instrument to less than six inches when it is folded and adds greatly to convenience. (Fig. 1) The straps shown are for the purpose of attaching the instrument to the limb when so desired. They are provided with little loops to carry the arms of the instrument.

In taking observations with this or any other instrument of the protractor type it is necessary to establish a base line and the axis of motion for each joint. (Figs. 2 to 16). The base line is in the axis of the limb and crosses the axis of motion at a right angle. The reading is taken by placing the instrument so that its little axis pin is over one end of the axis of motion of the joint under observation, the upper arm corresponding as nearly as possible to the long axis of the bone above the joint and the other arm in the same relationship to the bone or bones below; the upper arm of the instrument being held firmly in position, either by the hand or the straps, the lower bone member of the joint is moved in one direction to its full extent and the reading taken on the scale; motion is then made in the same way in the opposite direction and the reading again taken; thus we have the number of degrees of

motion allowed and the relationship of the extreme positions to the axis of the proximal bone; for example, the ankle joint has its axis of motion directly in line with, and about ½ inch below the internal malleolus, the degree of dorsal flexion being to 45 degrees on the axis of the leg and the degree of plantar flexion, or extension, to 135 degrees on the same axis or a range of motion of 90 degrees. For those motions having their axis in the long diameter of a limb we take the measurement at the end of the limb except for shoulder rotation which we

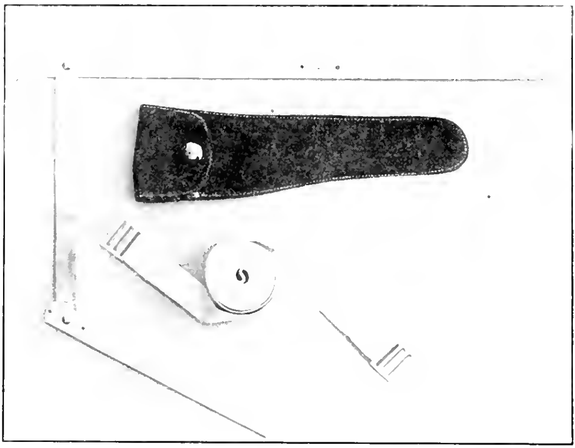

Figure 1.

can best estimate at the flexed elbow; pronation and supination is measured at the closed fist and femur rotation at the sole of the foot with the leg fully extended at the knee.

It is desirable to adopt some sort of a provisional standard of the normal range of motion for each joint. As indicated above it is possible to select certain motions and by measuring their amplitude in a definite manner to attain a certain degree of accuracy. As the range of motion will vary in different subjects, as from the amount of soft tissues over the joint or from other causes, it is best to take as the standard for any

joint the range of motion of the corresponding joint on the opposite side of the body, providing it is present and is not also disabled. In order to provide some sort of a gross standard for the normal range of joint motion the following brief descriptions of certain essential movements is given. Most of the cuts to illustrate the movements described were worked out by C. F. Sonntag and were used by him in case recording at Sheperd's Bush Military Hospital during the war. Some of them have been slightly altered by the writer to conform to the range of motion as elicited during experiments and a few additional cuts drawn to show additional movements.

Movements at the Shoulder Joint. The arm is attached to the body at the shoulder through the medium of the shoulder girdle, which may be said to be in the form of an arch having but one point of direct, ligamentous attachment, to the skeleton, namely at the inner end of the clavicle, or what may be called the anterior end of the arch; the posterior end of the arch is the scapula, lying between planes of, and actuated by certain muscles of the back. The principal motion of the scapula is one of rotation in a plane corresponding to its flat surface on, roughly speaking an antero-posterior axis near the clavicular attachment of the coraco-clavicular ligament. At the outermost portion of the shoulder girdle, corresponding to the place for the keystone of the arch, to carry the simile through, is the glenoid cavity receiving the head of the humerus, which is held to the shoulder girdle by a very loose capsular ligament, which allows very free motion of the humerus. The movement of the arm on the body is in all directions, forward, backward, abduction, adduction, rotation and circumduction. From a position in which the arm hangs at the side with its axis corresponding to the long axis of the body, the arm may be made to move backwards through an arc 45 degrees, and forward through an arc of 180 degrees, or pointing directly upward. From the same position it may be moved in the direction of abduction through an arc of 180 degrees also pointing directly upward. Of the two latter motions it may be said that the first 90 degrees represent principally motion at the humero-glenoid articulation, but that the latter part of the movement involves greater scapular movement, though in the normal individual the entire motion is compound, that is, there is motion both at the humero-

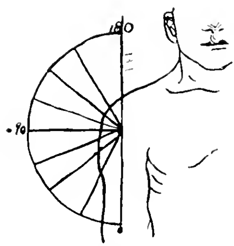

Fig. 2.

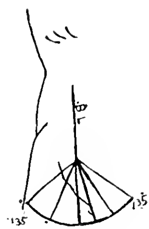

Fig. 3

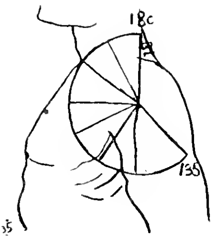

Fig. 4.

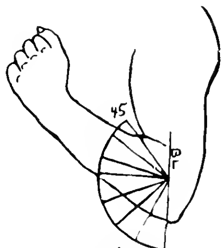

Fig. 5

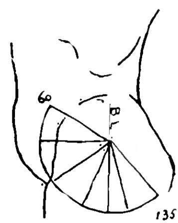

Fig. 6

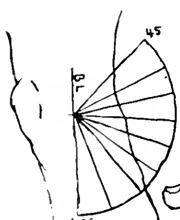

Fig. 7.

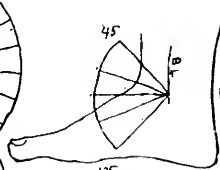

Fig. 8

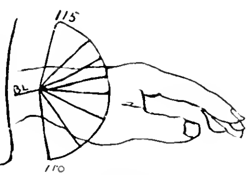

Fig. 9.

Fig. 2. Abduction of arm at shoulder.
Fig. 3. Abduction and adduction of leg at hip.
Fig. 4. Forward and backward movement of arm at shoulder.
Fig. 5. Flexion of elbow.
Fig. 6. Flexion and extension of leg at hip.
Fig. 7. Flexion of knee.
Fig. 8. Flexion and extension of foot at ankle.
Fig. 9. Flexion and extension of hand at wrist.

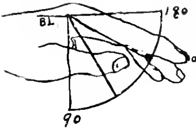

Fig. 10.

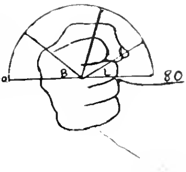

Fig. 11.

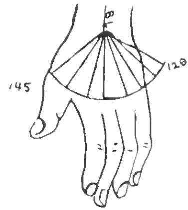

Fig. 12.

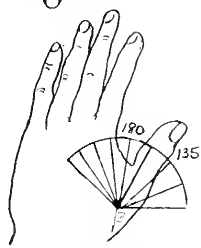

Fig. 13.

Fig. 14.

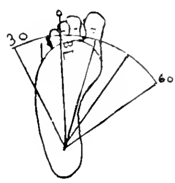

Fig. 15.

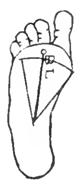

Fig. 16.

Fig. 10. Flexion of fingers at metacarpo-phalangeal joint.
Fig. 11. Supination and pronation.
Fig. 12. Radial and ulnar flexion at wrist.
Fig. 13. Abduction and adduction of thumb.
Fig. 14. Inversion and eversion of foot.
Fig. 15. Rotation of leg at hip.
Fig. 16. Abduction and adduction of foot at mid-tarsal joint.

Note: Base line is marked B. L.

glenoid joint and on the part of the scapula throughout the upward motion of the arm. To estimate the first part of this upward movement of the arm the scapula must be held firmly. With the arm abducted to 90 degrees and the fingers pointing upward, it will be seen that there is possible forward rotation of 90 degrees, which can be seen as the hand is allowed to fall forward. In this position an additional movement downward of the forearm of 100 degrees or more is possible by movement of the scapula. This movement of rotation of the head of the humerus can also be demonstrated with the arm in the hanging position and the forearm pointing directly forward, in this case, however, the rotation of the head of the humerus is inward. The measurement of circumduction is not recommended because it is not a simple movement and is not considered to be of great clinical help.

Movement at the Elbow Joint. The motion of the forearm on the upper arm is from full extension or 180 degrees to flexion of from 55 to 45 degrees. There is normally no lateral motion. The superior radio-ulnar articulation is usually thought of as being part of the elbow joint. We should dissociate them in our minds and thereby greatly simplify our examinations of this region.

Movement of Supination and Pronation. From a position of full supination or with the palm directly upward the hand may be turned inward and downward through an arc of 180 degrees until the palm is directly downward. Any extension of this movement beyond that mentioned represents rotation of the humerus. The mechanics of pronation may be described as a rotation of the head of the radius (pivoting) inward at the superior radio-ulnar joint: there is of course just as much inward rotation at the wrist or inferior radio-ulnar joint and in addition the lower end of the radius describes an arc, at first upward and inward and then downward and inward, about an axis in the lower extremity of the ulna. From this it will be seen that motion at the lower end of the radius is more of a hinge than a pivot joint as usually described. The ulna is absolutely neutral in pronation or supination, any doubt of this may be dispelled by the examination of an elbow joint on the skeleton when it may be seen that the ulna is adequately prevented from any motion except flexion and extension on

the upper arm. The mechanics of supination exactly reverses the process of pronation.

Movement at the Wrist Joint. Disregarding pronation and supination the movements at the wrist joint are flexion and extension, abduction and adduction, or what for the last two are much better terms, radial and ulnar flexion; in addition there is, through a combination of the movements mentioned, circumduction. Flexion is possible to 110 degrees on an axis through the proximal row of carpal bones at about the level of the pisiform. The hand may actually be flexed to 90 degrees on the forearm but the range thus attained is not in the wrist but rather from movement of the carpal bones. Extension is possible to 115 degrees on the same axis as flexion. Radial flexion is possible to 145 degrees on an axis through the proximal edge of the semilunar bone, while ulnar flexion is possible to 120 degrees on the same axis.

Movement in the Carpus. Is difficult to measure, although about 15 to 20 degrees may be demonstrated by forcing the hand into extreme flexion after the maximum has been attained from the wrist joint.

Movements of the Fingers. The movement of the fingers at the metacarpo-phalangeal joint are flexion to 90 degrees, radial and ulnar flexion of varying amounts and circumduction. The phalangeal joints should allow flexion until fingers close on themselves.

Movements of the Thumb. The thumb is capable of abduction, adduction, flexion, extension and circumduction. The metacarpal bone of the thumb articulating with the trapezium adducts to 180 degrees or to a straight line to the forearm and abducts to about 135 degrees. Flexion at the metacarpo-phalangeal joint is from full extension (180 degrees) to 120 degrees. It will be observed that full adduction, that is with the thumb across the palm is only attained through the flexion movement at the metacarpo-phalangeal joint.

Movement at the Hip Joint. The movements of the femur at the hip joint are flexion, extension, abduction, adduction, rotation and circumduction. All movements may be more free in women than in men. Flexion is only limited by contact of the thigh with the abdomen a relation of from 60 to 50 de-

grees to a line in the long axis of the trunk. Extension, limited by the ilio-femoral ligament and the front of the capsule is about 135 degrees. Adduction is limited, strictly speaking, by contact with the opposite leg but with slight flexion and rotation may be carried to about 135 degrees. Abduction, limited by the outer band of the ilio-femoral ligament, the ilio-trochanteric ligament and the outer part of the capsular ligament is to about 50 degrees. Rotation outward is limited by the outer band of the ilio-femoral ligament and inward by the ischio-capsular ligament and back of the capsule. The range of this movement is about 90 degrees. The measurement should be made with the patient recumbent and the toes pointing directly upward when it may be observed that by turning the knee outward the forefoot may be made to describe an arc of 60 degrees outward and inward of 30 degrees, both measurements, of course, being from the perpendicular.

Movement at the Knee Joint. At the knee joint there is possible but one motion namely flexion of the lower leg on the thigh from full extension of 180 degrees to full flexion of 45 degrees on the thigh. This is not a simple hinge movement because the head of the tibia makes an excursion through an arc of a circle in a backward and downward direction as the leg flexes.

Movement at the Ankle Joint. At the ankle joint the foot flexes dorsally to 45 degrees on the line of the leg and plantar flexes to 135 degrees on the same line. There is no lateral motion normally in the ankle joint except by some spreading outward of the lower end of the fibula, which of course it is best to disregard in measuring.

Movement at the Mid-tarsal Joint. The mid-tarsal joint is made up of two articulations; the astragalo-cuboid and calcaneo-cuboid. The principal motion permitted is of the forefoot in the direction of adduction and abduction on a vertical axis; motion of the forefoot is also possible on an antero-posterior axis in the direction of inversion and eversion and on a transverse axis allowing flexion and extension. Careful consideration of the movements at the mid-tarsal joint is of prime importance in the examination of disabilities of the foot. In estimating the amount of flexion at this joint the ankle must be held immobile.

Conclusion.

While the careful methodical measurement of the amplitude or range of motion of joints offers an opportunity to obtain valuable clinical data, it is even more valuable to record the progress toward complete recovery of certain types of joint disability. Taken in connection with measurement of muscle power the usefulness of the proceedure is, in certain cases, increased.

A simple type of instrument should be used. It is not possible in the ordinary hospital to have a mensuration department and therefore the more cumbersome instruments are not recommended.

As all bones move from the joint on an arc of a circle we may accept measurements reading in degrees as recorded on the ordinary quadrant or protractor scale, but it would seem most desirable that all observers use the same method of taking and recording their measurements, and this necessitates the use of a constant base line for each joint, and that the angle be taken in relation to this base line. Doubtless no better base line can be found than the long axis of the proximal bone member of the joint under observation. For the shoulder and hip we use a line parallel to the long axis of the body and stopping at the anterior end of the axis of the motion. For rotation of the humerus and femur we use a vertical, in the first at the flexed (90 degrees) elbow and in the second at the sole of the foot. For supination and pronation the most convenient base line is a horizontal line across the closed fist with the hand in full supination.

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STOFFEL'S OPERATION FOR SPASTIC PARALYSIS, WITH REPORT OF THIRTY-TWO CASES.

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Read at Toronto at the 1920 Meeting of the American Orthopedic Association.

In an article on "The Surgery of Spastic Paralysis," Annals of Surgery, May 1918, Volume 67, Number 5, I discussed briefly the surgical procedures employed in the treatment of spastic paralysis, and made a preliminary report of cases operated on by the Stoffel method of peripheral neurectomy of motor nerves. The reader should study Adolf Stoffel's paper "The Treatment of Spastic Contractures" which appeared in the American Journal of Orthopaedic Surgery, May 1913, Volume 10, Number 4. I performed my first Stoffel operation in February, 1914, at the suggestion of Dr. A. P. C. Ashhurst, whose assistant I then was at the Orthopaedic and the Episcopal Hospitals. Since that time I have operated on thirty-two patients, in whom partial neurectomy has been performed thirty-four times on the popliteal nerve, twenty-seven times on the obturator nerve, six times on the median nerve, and five times on the sciatic nerve—a total of seventy-two operations. In this present paper I shall report these cases in detail, and shall discuss the Stoffel operation and consider the position which it should take in the treatment of spastic paralysis.

It seems best to consider this subject in the manner in which the orthopaedic surgeon confronts it in his daily experience. I shall not deal with the causes of spastic paralysis nor with the various forms it assumes, except so far as they are related to the treatment.

Clinical Varieties

The patient presents evidences of spasticity of the muscles of one or more extremities. The muscle reflexes are exaggerated. The stronger groups of muscles usually have overcome by constant tension the feebler groups, and have produced a certain state of deformity of the member. A condition of apparent contracture of the stronger muscles is present. In the upper extrem-

ity this is manifested in flexion of the elbow, the wrist, and the fingers, and in pronation of the forearm. In the lower extremity it is manifested in the adduction of the thighs, the flexion of the knees, and the plantar flexion of the feet. The amount of spasticity and the degree of contracture vary widely in different cases. In some, active motion of the affected member is entirely absent, e. g., the foot is fixed in extreme plantar flexion, so that the patient is unable to move it. In others, the contracture is more moderate, and the patient has partial active motion, e. g., he may be able to dorsiflex his foot to a right angle, and plantarflex it to the normal limit. In still another group of cases active motion may be almost or altogether complete, but the patient has difficulty in originating and carrying out the motions, e. g., the hand and fingers may be held usually in a position of flexion, but the patient is able, after some delay, and possibly with the assistance of his other hand, to extend his wrist and fingers practically to the normal extent, and actively to flex them again. In such cases no contracture is present, but the cerebral control of the member is lessened. Motions are delayed and slow and are not always to be depended upon when desired.

Many of the patients are seen by the surgeon before they have learned to walk. Others may be able to walk with considerable difficulty when assisted by a supporting hand. Others may walk fairly well but usually with a certain degree of adductor, hamstring, and Achillis contracture, so that the knees strike together or cross each other and are kept in partial flexion and the heels do not touch the ground. In a fairly large proportion of cases these patients are mentally deficient, and some are even completely idiotic. They are nearly always slow in learning to talk and to walk. Not infrequently cases are met which have reached the age of puberty without being able to do either.

The tendency among orthopaedic surgeons has frequently been to consider these backward children as more or less hopeless, and to decline to undertake treatment because of the length of time and the amount of attention that are required, and because of the discouraging results that are often obtained; but certainly if no orthopaedic measures are employed these needy cases will not improve of themselves. It is unquestionable that many cases can be very greatly helped, and that some improvement can be secured in almost all. In a low grade idiot improvement may in-

deed be insufficient to justify a long course of treatment. But there are many cases on the border-line who should be given the advantage of reasonable doubt. If it is possible for the surgeon to enable these individuals to walk, a great deal will have been accomplished in adding to their usefulness and to the comfort of their families.

Preliminary Treatment

The object of all treatment is to secure restoration or improvement of function. If a patient is unable to walk the aim of the surgeon is to enable him to do so, even by the use of crutches and braces if necessary. If he is able to walk with difficulty the object is to improve his locomotion. If the disability is in the upper extremity treatment is for the purpose primarily of securing better function of the hand so that the patient may have an enlarged field of usefulness in life and, secondarily, of improving the appearance of the hand and of relieving painful or uncomfortable spasm of the muscles.

In examining these cases the surgeon should note the extent of the spastic paralysis, the comparative difference in the strength of antagonistic muscles or groups of muscles, the degree of contracture and its condition as to whether it is permanent or temporary, the amount of disability in the member, the mentality of the patient, and his social condition. One should know also whether or not the patient has been neglected or whether he has received intelligent treatment. The surgeon may then outline the course of treatment which may be necessary to arrive at the definite end of return or improvement of function.

If the patient can remain under the care of the surgeon as long as is desired, a preliminary course of treatment should be undertaken before any operative procedure is considered. If the circumstances are such that whatever can be done should be done quickly, then immediate operation may be performed. If a patient has already had careful treatment which has been largely in the way of prophylaxis to prevent deformity, the preliminary treatment may be dispensed with. This treatment is undertaken for the purpose of improving function as far as possible before surgical operation is resorted to, and to enable the surgeon the better to decide what operation, if any, may be required. If the patient has a marked talipes equinus so that he stands or walks

upon his toes, and has no active dorsiflexion of the foot, the surgeon may be unable at once to decide what operation may be necessary or how far the operation should go in order to secure a good result. The anterior muscles of the leg appear to be completely paralyzed; but if, with or without an anesthetic, the foot is dorsiflexed and the knee extended and the extremity put in plaster-of-Paris in an overcorrected position for a period of four to six weeks, it may be found at the end of this time that the anterior leg muscles have recovered considerable power, and that the patient has considerable active dorsal and plantar flexion of the foot. If this improvement is maintained by means of a brace and if massage and painstaking active exercises are instituted, with possibly the use of the Galvanic current, still further improvement may be secured. It may be found that no operation is necessary. If, however, the foot shows marked tendency to return to its former position of equinus, or if sufficient improvement has not taken place the surgeon is then in a position to note to what extent the Stoffel operation should be carried. The same observation holds true for deformity of the upper extremity.

It must be borne in mind that in spastic paralysis the element of spasticity far overshadows the element of paralysis. Indeed, a real or complete paralysis is very rarely present. All muscles are spastic, but the strong muscles have overcome their weaker antagonists, and produced a deformity. The weaker muscles are thus still further weakened by over-stretching and by being placed in a bad mechanical position; and the stronger muscles become still more spastic by the approximation of their points of origin and insertion. One object of all methods of treatment including the Stoffel operation is simply to secure more or less muscle balance, so that the weaker muscles or muscle groups may not be overcome by more powerful antagonists, but may be able to exercise their proper function. In normal individuals the play between antagonistic groups of muscles is under cerebral control, but in cases of spastic paralysis this control has been more or less lost. When the muscle balance has been approximately restored the patient may regain almost normal active motion of the member, or he may secure but feeble and delayed motion. In still other cases the amount of active motion secured may be very slight, but the patient is benefitted by the removal of the deformity and the consequent improvement of function. In

addition, the cosmetic appearance has been greatly improved, a consideration of no mean value in the upper extremity.

If the surgeon by means of the Stoffel operation has secured more or less muscle equilibrium he must not consider his task ended, for a long and careful course of after-treatment is necessary. The weaker muscles which have so long been at a disadvantage must be carefully strengthened and trained. For this purpose massage, Galvanic electric current, manipulation of the joints, and above all careful active exercises must be carried out. Braces may be necessary to prevent relapse. It may be found that too little resection of the nerves has been done, and a second operation will be necessary. Of course, when the mentality of the patient is fair or good the improvement will be much more rapid. Idiotic children may be unable to assist in any way and the surgeon may have to be content with the elimination of the deformities present. Such patients may possibly learn to walk with the use of braces and by the employment of an apparatus such as a wheel-crutch.

Purpose of the Stoffel Operation

We consider now the operation in itself. As has been stated the deformity in the patient is due to muscle unbalance. The disability is due in part to the deformity and in part to the spasticity and greater or less interference with normal cerebral control of the muscles. The operation aims to remove the deformity and as well to break the vicious circle of the peripheral arc, which produces the spasticity. In my article on spastic paralysis, previously referred to, I have described the establishment of this vicious circle and the means employed to break it. I shall not discuss it here; it is sufficient to say that the Stoffel operation does more or less cut this circle and relieve to a greater or less extent the spasticity. When this has been accomplished it is found that the brain in most cases is able to exercise more or less control over the peripheral arc. Therefore, we may say that the object of the Stoffel operation is twofold; to remove deformity, i. e., contracture, and to secure better cerebral control of the members. The operation consists in the excision of a portion of the nerve supply to the strong and contractured muscles. This produces a partial or complete paralysis of these muscles. The amount of paralysis or weakening of a muscle group should be sufficient to

cause a muscle balance between this group and the antagonistic muscles. If this be overdone the antagonistic muscles may in turn overcome those which were formerly the stronger and produce a deformity opposite to the original one. Therefore, the chief element in the operation is the matter of judgment as to how large a portion of the nerve supply to any muscle or any group of muscles as a whole should be excised. This is somewhat a matter of experience; and until this experience has been gained the surgeon should err by doing too little rather than by doing too much, as he can always return to resect more nerves if necessary, but he cannot replace nerves already resected. Let me here emphasize again the importance of preliminary treatment to enable the surgeon to judge how far he should proceed with his nerve resection.

Technic of the Operation

Let us now consider the method of operation upon the various nerves. First, the median nerve. The common deformity in the upper extremity has been already described. I have not found it necessary to operate for flexion contracture at the elbow. But it is possible in certain cases that a portion of the nerve supply to the biceps muscle might require resection. The median nerve is exposed in the bend of the elbow. The incision need not be more than two inches in length. The nerve is freed from surrounding tissue, and partially retracted out of the wound, and supported on a grooved director or a haemostat, placed transversely. On the anterior aspect of the median nerve adjacent to the biceps muscle is to be seen a nerve tract or cord. A portion of this separates itself from the median nerve and goes directly to the superficial head of the pronator radii teres. This is the first branch to leave the median nerve in the flexure of the elbow. This branch should be entirely resected for a distance of several inches. It can be cut off below near the point where it enters the muscle, and can be dissected up from the median nerve any desired distance. The remainder of the tract already described consists of the nerves to the flexor carpi radialis, the palmaris longus, and the deep head of the pronator radii teres. These bundles of nerves are to be freed from the remainder of the median nerve and from one another and to be tested by the electrode. In severe cases of pronation and flexion contracture all of these nerves should be excised. In less

severe contracture one may split the nerve to each muscle and may resect approximately one-half to three-fourths of it. The nerve to the pronator quadratus is to be found in the dorsal portion of the median nerve. Usually it should be left intact, but in very severe cases it may be resected. In none of my cases have I found this resection necessary. The median nerve is now further separated into its constituent bundles. It will be found that the nerve supply to the flexors of the fingers is on the dorsal and ulnar aspect. These bundles should be freed from the remainder of the median nerve, separated from each other and tested by the electric current. Such portion of them may be removed as is demanded by the severity of the contracture. The remainder of the median nerve consists of the sensory tracts, and of the motor nerves for certain intrinsic muscles of the hand. It is thus found that the median nerve consists of a definite number of nerve bundles or funiculi, which like cables are bound together. The tracts to the various muscles always occupy the same relative position in the nerve; in other words, the nerve has a definite topography or internal structure which is always the same. The surgeon will soon learn by observation the position of these various bundles, and may in time learn to dispense with the use of the electrode; but in his earlier cases it is advised that he test always each bundle after it has been isolated to determine which muscle it supplies. One may use the ordinary brain electrode, or one may have made a special electrode for this purpose. It will be found that very slight stimulation is necessary to secure response in the muscle. If a strong current is used there is danger of its spreading from one bundle to another, thereby confusing the surgeon as to which bundle of nerves he has isolated. The least strength of current necessary to produce muscular contraction should be employed. It is found that these spastic muscles respond to slighter stimulation than do normal ones. The surgeon has now produced a certain amount of paralysis of the muscles of pronation and of the flexors of the wrist and fingers. He has left, of course, untouched the ulnar nerve, which also supplies a portion of the flexors of the wrist and fingers. It may be attacked in a similar manner at a later operation if necessary.

Second, the obturator nerve. The anterior branch of the obturator supplies the gracilis, the adductor longus and all or a por-

tion of the adductor brevis. The posterior branch supplies the obturator externus, the adductor magnus, and at times the adductor brevis. Certain other muscles aid in the adduction of the thigh, notably the pectineus, which is supplied by a branch from the anterior crural, and the hamstring muscles which are supplied by branches of the sciatic. The dorsal portion of the adductor magnus frequently receives nerve supply through the great sciatic nerve. The adductor magnus is frequently divided into two distinct portions. The upper part of the anterior portion is usually quite separated from the rest of the muscle and has been termed the adductor minimus. It is therefore clear that if the anterior branch of the obturator nerve be excised a considerable degree of adduction remains in the muscles supplied by the posterior branch and by the other nerves just mentioned. If the posterior branch be excised in addition to the anterior the patient still possesses power of adduction through the pectineus, the dorsal portion of the adductor magnus, and through the hamstrings in certain positions of the thigh. Therefore in moderate degrees of spasticity the entire anterior branch of the obturator nerve is excised. In severe degrees both branches are excised. I have found it necessary only on one occasion to excise the posterior branch as well as the anterior. The technic of the operation is as follows:—an incision two or three inches in length is made from the pubic spine downward along the tendon of the adductor longus. This tendon is identified, and a blunt dissection is made by the handle of the scalpel or with the fingers along its inner margin. Dissection should never be made through muscle substance but always in the cleavage planes between the muscles. The tendon of the adductor longus is then retracted outward and the anterior branch of the obturator nerve is clearly seen running in the intermuscular fascia. If one division only of the anterior branch is observed it may be lifted upon a small hook and the blunt dissection carried proximally until the main stem of the nerve is isolated. The main stem is found to divide usually into three branches. The dry dissection is carried up to the obturator foramen. The posterior branch of the obturator can then be seen issuing from the foramen, or running backward behind the anterior fibers of the obturator externus, and behind the adductor brevis. If the anterior branch alone is to be resected the main stem is clamped by a haemostat, and is divided above the haemostat. The various

branches are then divided several inches lower as they are seen entering their respective muscles. If the posterior branch is to be resected also, it is removed in a similar manner. One or two sutures are placed in the deep fascia and the skin wound is closed.

Third, the sciatic nerve. This is attacked to overcome contracture of the hamstring muscles. The nerve is exposed without difficulty by an incision begun at the gluteal fold, and running downward for four or five inches, and placed about midway between the tuberosity of the ischium and the great trochanter. After the deep fascia has been incised the long head of the biceps muscle is identified. This muscle is then retracted inward and the dissection continued along its edge until the sciatic is encountered. On the median aspect of the nerve is found the cord which supplies the long head of the biceps, the semimembranosus, and the semitendinosus. This tract or cord is separated from the main trunk of the sciatic nerve, is lifted by a hook or an elevator, and is then dissected into its component parts. These three nerves are identified by means of the electric needle. In moderate degrees of spastic contracture the nerve to the biceps and the nerve to the semimembranosus are excised completely. In severe cases of contracture the nerve to the semitendinosus is split and about one-third of it is resected. The surgeon therefore in the first instance, leaves intact the short head of the biceps and all of the semitendinosus, and in the latter instance the short head of the biceps and on the median side the greater part of the semitendinosus. These two muscles are sufficient to secure active flexion of the knee, but their united power is not sufficient to overcome the extensor muscles of the thigh.

Fourth, the internal popliteal. Operation is made to correct pes equinus or pes equino-varus. This nerve is exposed in the center of the popliteal space. Here it lies only superficially and is easily approached. Blood vessels and other structures lie deeper. The nerve is lifted from the wound and placed across a grooved director. It is well freed upward and downward from surrounding tissue. The first branch seen to be coming from the nerve leaves on the internal and posterior aspect and immediately pursues a superficial course. This is the sensory branch called the nervus cutaneus surae medialis or the tibialis communicans. The next two nerves to leave the main trunk are the nerves to the

outer and inner heads of the gastrocnemius muscle. Running beside these two nerves is the nerve to the dorsal portion of the soleus, and the nerve to the plantaris. The common tract containing these nerves lies on the dorsal or superficial aspect of the internal popliteal nerve. The ventral portion of the soleus muscle is supplied by a special tract which lies on the antero-external aspect of the nerve. The nerve to the tibialis posticus will be found on the posterior or the posteroexternal aspect. That for the flexor longus digitorum on the postero-median aspect. In moderate cases of pes equinus the two nerves to the heads of the gastrocnemius alone are resected. In slightly more severe cases a portion approximately one-half of the nerve tract to the dorsal portion of the soleus is also excised. In still more severe cases this entire tract is excised. If it is found in the severe cases that the flexor longus digitorum is materially aiding in producing the deformity a portion of its supply must also be resected. If the tendency to pes varus is marked a portion of the supply to the tibialis posticus must be taken. After the nerves have been resected the remainder of the internal popliteal nerve is droppd back into its position where it lies embedded in fat. The deep fascia is brought together by a few sutures and the skin wound is closed.

When the patient is under the full influence of the anesthetic it is usually found that all contractures which were present before operation have disappeared. In other words, the contractures were spastic contractures, and not atrophic, such as occur in infantile paralysis. This demonstrates the impropriety of the old operation of tenotomy or tendon lengthening, whereby tendons of muscles were lengthened where no actual shortening was present and an opposite deformity was produced in many cases, e. g., a pes equinus was transformed into a pes calcaneus, which is the more disabling of the two. If it is found at the time of operation that contracture of the tendons still is present then we know that real shortening has occurred, and tendon lengthening should be done in addition to the nerve resection. However, this tendon lengthening should be performed only in case the surgeon is unable by manipulation to stretch the tendon. I have not infrequently found contracture remaining during the anesthesia but I have almost invariably been able to overcome it by forcible correction.

After-Treatment

My method of after-treatment varies somewhat from that recommended by Stoffel. He employs starch bandages, splints, and sand bags in all cases to maintain overcorrection, and avoids the use of plaster-of-Paris. In all cases of spastic paralysis of the lower extremities in which the contractures disappear spontaneously under the influence of the anesthetic, I employ no after-fixation. If forcible correction is necessary to reduce the contracture then I fix the member in an over-corrected position in a light plaster cast for two or three weeks. If I find within a week after operation that some tendency to contracture persists in the former class of cases I may then put the member in a plaster cast, with or without the use of an anesthetic, for a short time. It is often remarkable and astonishing on observing a patient the day following the operation, to find how completely his deformities have disappeared, and how considerable a degree of active motion he has in the direction where formerly he had little or none. If the proper preliminary treatment has been employed before operation the less likely is one to require any means of fixation after operation. As soon as the wounds have healed, which is at the end of a week, the patient is gotten out of bed and is sent to the gymnasium where he receives careful instruction in muscle training and in walking. The child is hereafter encouraged to walk as much as possible without becoming fatigued. He is no longer a bed-patient unless walking is absolutely impossible for the time being.

During my early operations I handled the nerves with great gentleness, making dissection of the component parts with extreme care. I soon found that this is unnecessary. While the nerve should not be handled roughly one need not delay the operation by extremely delicate dissection. Occasionally if the surgeon abuses the sensory tracts in the nerve the patient may complain for some days after operation of some numbness or tingling in the course of the distribution of these tracts. This is more apt to be the case in the operation upon the median nerve. I have never observed it in operating on the internal popliteal nerve and but once have I seen it in operation on the median when a complete dissection was made of all the tracts of the nerve. Ordinarily one does not touch the sensory tracts. He is familiar enough

with the topography of the nerve to isolate the tracts desired with but little dissection of the remaining portion of the nerve.

The after-treatment has been mentioned. The patient may require no apparatus. If any measures are needed to correct a pes valgus or a returning inclination to pes equinus appropriate apparatus or pads in the shoes should be prescribed. In treating the upper extremity I think greater care must be exercised. It will usually be found better to apply a light cast immediately after the operation with the forearm and the hand in a position of overcorrection. Afterwards the wrist and fingers should be kept on a splint in a hyperextended position for a period of possibly three or four months. The hand should be taken from the splint frequently during the day for treatment and exercise. A little later the splint may be cut off so that free motion of the fingers is permitted while the wrist is still maintained in hyperextension. Care must be taken always to avoid over-fatigue of any of these patients. While they are encouraged to make active movement yet it must not be overdone. This is a very important note of warning.

Indications for Operation

It is clear from what has been said that not every case of spastic paraylsis is suitable for operation. Those are the most suitable which have a fixed deformity due to contracture of one or more of the muscle groups which have been enumerated in the various operations described above, whether they be due to a cerebral or to a spinal lesion. These cases of spasticity whose members are not in any fixed position but assume first a position of flexion and then one of extension, or those patients with athetosis are not suitable for operation. However, there is one group which may be called that of mild contracture. In this a certain mild deformity is usually present but it can be voluntarily corrected, or can be readily corrected by manipulation. When the patient becomes excited the spasm and the deformity are exaggerated. This class is suitable for the Stoffel operation, but only a small portion of the nerve supply to the stronger muscle groups should be excised. The operation is contraindicated furthermore in the most severe phases of Little's disease, with diffused spasm in almost the entire body, and in progressive diseases, such as progressive multiple sclerosis, and those extreme cases of idiocy in which the

patient would never be able to walk, even if the deformities were corrected and the spasticity reduced. Hemiplegias, whether in children or in adults may often be found suitable for operation.

Report of Cases

No. 1. R. J. Aged 7 years. Spastic paraplegia, present since birth.

February 6, 1914. Walks on toes, crosses legs in walking, and is very unstable. Operation, tenotomies of adductors, hamstrings, tendo Achillis of left leg; and Stoffel's operation on anterior branch of the obturator, and portion of the branches of the sciatic to the hamstrings, and portion of branch of the internal popliteal to gastrocnemius and soleus of right leg.

January 9, 1915. Very much improved. Walks fairly well with braces, heels come to the ground. Knees are not flexed, toes are no longer dragged.

September 23, 1916. Braces removed.

August 25, 1917. Right foot is good, toes straight, but there is slight tendency to equinus. Left foot is in marked calcaneo-cavo-valgus. Brace reapplied to left leg, to hold foot straight.

March 9, 1918. Right foot is firm on the ground with knees straight. The thighs are well apart. Good active flexion and extension of ankle. On the left side there is no adduction and no contracture at the knee but the foot is in marked calcaneo-valgus.

June 28, 1918. Operation, left foot, horizontal transverse section, and shortening of tendo-Achillis.

December 13, 1919. Left foot is solid. No lateral deformity. The heel comes to floor at the same time as the ball of the foot, with the foot in slight dorsi-flexion. Has a few degrees of active motion in the ankle. Knee is straight. Legs are well apart in walking. No tightness of adductor tendons on either side. In the right foot there is active dorsi-flexion to about 90 degrees. The entire foot rests on the floor when standing with knee extended, but when walking the toes strike the ground first and then the heel comes to the ground. She walks fairly well without any support.

RESULT. Walking very considerably improved. The tenotomy of the left tendo-Achillis led to a marked pes calcaneo-valgus which required a later operation to correct.

No. 2. E. W. Aged 5 years. Spastic hemiplegia, which followed convulsions when eight months of age.

January 26, 1914. Marked disability of right arm and right leg.

March 25, 1914. Operation, tenotomy of tendo-Achillis.

July 27, 1914. Walks well, heel comes to the ground. The right hand and fingers are moderately flexed and the thumb is adducted and flexed.

September 29, 1914. Operation on median nerve.

October 26, 1914. Active motion of elbow 55-140 degrees. Active extension of wrist to 180 degrees. Active extension of fingers to normal. Thumb remains flexed into the palm. Inability to flex fingers completely.

July 17, 1916. Active motion of elbow 45-180 degrees. Hand is fairly straight. Thumb is flexed into the palm. Inability to make complete fist. Passive supination normal, active supination about one-half normal. Walks with heel on ground and foot straight.

February 14, 1918. Foot in good position, heel on ground, walks well. Passive supination complete, active about one-half normal. Some tendency for hand to be flexed at wrist. Passive extension of fingers, wrist and thumb normal. Active extension partial. Brace advised to maintain hand in hyperextension.

January 20, 1919. Grasp is good. Wrist, fingers and thumb are held slightly flexed, and the thumb is adducted into the palm. At times she is able to extend the fingers to a straight line and the wrist almost to a straight line. Passive hyperextension of fingers, wrist and thumb are normal. Patient has benefitted by the operation but has lacked development of the extensor muscles by exercises.

RESULT. Tenotomy of tendo Achillis satisfactory. Function of the hand considerably improved, appearance of hand very greatly improved.

No. 3. F. E. Aged 13 years. Paraplegia. June 26, 1914. Was operated upon nine years ago by Dr. Willard, who did tenotomies at the hips and tenotomies of hamstrings and probably of the adductors. Able to stand with support to balance him. Can walk sideways when supported by both hauds. Stands with marked back knee, pronated feet, legs far apart. Right upper extremity fairly normal, left upper extremity—cannot raise arm above head or to behind back. Triceps and biceps weak. Grasp is weak. Wrist slightly flexed. Active extension of wrist limited to 180 degrees. Thumb cannot be abducted. Distal phalanges are in hyperextension, lead-pipe spasticity of elbow. Lower extremity—slight motion, active, at hips. No active flexion of knee. Slight active extension. No motion of ankles. Tendo Achillis contractured. Marked ankle clonus, marked quadriceps clonus.

July 4, 1914. Stoffel operation on both internal popliteals. Right leg: a portion of the nerve to the soleus, all of the nerve to one head of gastrocnemius, two-thirds of nerve to other head of gastrocnemius excised. Left leg: both nerves to the gastrocnemius and two-thirds of nerve to soleus excised.

July 15, 1914. Active dorsiflexion of feet. Can walk with little support.

August 8, 1914. Discharged. Fairly good use of legs.

RESULT. Improved. Deformity removed. Good active dorsiflexion of feet secured.

No. 4. T. F. Spastic hemiplegia since birth. July 17, 1916. Operation, median nerve. Patient left the hospital at the end of several months considerably improved. He has not been heard from since.

RESULT. Considerably improved. Have been unable to follow up the case.

No. 5. W. G. Aged 12 years. Spastic hemiplegia, left side. Occurred when two and a half years old.

July 13, 1914. Raises arm only partially above head and places it behind him with difficulty. Shoulder elevated. Trapezius slightly contracted.

Biceps and triceps have fair power. Arm is pronated, and cannot be supinated beyond the mid-position. Wrist is flexed, the thumb and fingers are flexed into the palm. No active extension of wrist. No motion in fingers, except for a little additional adduction and flexion. Walks on the toes of his left foot, tendo-Achillis is contracted. There is no active motion in the ankle. Ankle clonus present. Has hollow foot and hyperextension of great toe.

November 4, 1914. Operation, left median nerve, and the internal popliteal. It was found at the time of operation that the tendo-Achillis remained in partial contracture. It was lengthened and the extensor proprius hallicus was transplanted to the head of the first metatarsal.

December 7, 1914. Hand and fingers are straight. The thumb is not flexed into the palm. Arm can be supinated only to mid-position. Brace applied to maintain extension of wrist.

September 20, 1915. Uses hand quite well. Picks things up. Has a good grasp. Carries his school bag in his hand and holds things well. Active extension of fingers almost complete. Can make a good fist. Has slight control of thumb, but it usually remains adducted into the palm. No active supination. Can extend wrist feebly when elbow is extended. Slight radial deviation of the hand. Foot in good position. Patient has been greatly benefitted by the operation. Formerly he had not the slightest use of his hand, now he uses it well for many purposes. Walking has been improved very much.

RESULT. Very marked improvement in function of hand. Marked improvement in walking.

No. 6. W. A. Aged 27 years. Spastic paralysis of right lower extremity, probably a lateral sclerosis.

July 13, 1914. Walks with very spastic gait, with knees striking together. Uses cane.

November 14, 1914. Operation, Stoffel's on anterior branch of right obturator nerve.

December 14, 1914. Walks better. Is less spastic, can actively abduct thigh a little. Has foot drop.

February 8, 1915. Spasticity has increased. Patellar reflex and ankle clonus marked. Contracture of tendo-Achillis. No active dorsiflexion of foot. Unable to lift foot from ground in walking. Weakness of flexors of thigh.

February 11, 1918. Patient has been working for some time. Walks fairly well with cane. Knee jerk is exaggerated. Can lift foot from ground in walking. Slight active and passive abduction of thigh. Good flexion of hip. Full active extension of knee.

January 26, 1920. Patient reports by letter that he is working in New York City and that he is very greatly improved.

April 12, 1920. Patient has been working as a shoemaker and has been making $26.00 a week. He walks quite well with the use of a cane and with his legs well apart. No tendency to adduction deformity, otherwise condition remains about the same.

RESULT. Operation on the obturator nerve has proved satisfactory.

No. 7. F. W. Aged 14 years. Spastic paraplegia. Fell down stairs when ten years old. Was unconscious for a time, then had diphtheria. Lameness was noted three weeks later.

January 4, 1915. Typical spastic gait. Walking on toes, crossing knees and not lifting feet from the ground.

January 27, 1915. Operation, on both anterior obturators.

March 8, 1915. Patient walks much better, with knees apart, feet flat on the ground. Feet do not drag in walking.

Patient died before reporting again at clinic.

RESULT. Improved by the operation.

No. 8. C. J. Aged 23 years. Spastic hemiplegia. Resulted from bullet wound of head ten years ago.

March 20, 1915. Contracture of tendo-Achillis, pes valgus on standing, marked ankle and knee clonus.

March 24, 1915. Operation, Stoffel's on internal popliteal.

May 1, 1915. Patient states that he is much improved. Walks very much better. In good position. Is exercising the anterior leg muscles which are getting stronger. Active dorsiflexion of foot is good.

February 26, 1916. Good dorsiflexion of foot. Heel comes to ground and foot is straight. He has had excision of keloid scar in the popliteal space resulting from the old excision.

Patient died January 16, 1918.

RESULT. Greatly improved by operation.

No. 9. F. Y. Aged 15 years. Spastic hemiplegia, left side. Followed diphtheria when six years of age. Stoffel's operation by Dr. A. P. C. Ashhurst, June 13, 1914, partial excision of both nerves to the gastrocnemius and one to the soleus, excision of nerve to the pronator radii teres and partial excision nerve to flexors of hand and fingers.

February 8, 1915. Heel comes to floor in walking, but there is moderate pes valgus. Hand is still flexed and the arm is pronated, but is not so spastic as before operation.

April 12, 1915. Walks fairly well. Hand less spastic, but remains in flexed position most of the time.

April 21, 1915. Operation, Stoffel's on median nerve.

July 12, 1915. Voluntary partial extension of wrist and fingers, and partial active pronation and supination. Partial voluntary flexion of fingers, does not use her hand for anything. Patient cannot be traced. Final result not known. Immediate result was unsatisfactory as to function of hand, but it relieved the marked spasticity of the flexors of the fingers and the wrist.

RESULT. Moderate improvement.

No. 10. M. O'D. Aged 6 years. Spastic hemiplegia. Probably followed whooping-cough and convulsions when two years of age.

May 11, 1915. Walks with great difficulty. Contracture of tendo-Achillis and foot drop and pes varus. Toes alone come to the ground.

June 28, 1915. Operation, Stoffel's on popliteal nerve, excision of branches to the two heads of gastrocnemius, excision of portion of nerve to tibialis posticus.

July 6, 1915. Passive dorsiflexion well beyond 90 degrees. Heel on ground in standing and walking. Active flexion of some of the toes which was lacking before. Foot is held almost at a right angle when the stocking is put on. No varus.

February 26, 1918. When standing, foot is on floor and in good position, when walking there is a slight tendency to walk on toes. Passive dorsiflexion to 80 degrees. Active dorsiflexion incomplete. Mother states that child walks much better and is a great deal better in every way.

January 12, 1920. Mother states that she has steadily continued to improve. She walks quite well. Foot comes squarely to the floor and heel touches the ground. No lateral deformity. Fair active flexion and extension of ankle. Knee is held slightly flexed in walking but patient is able to extend it fully. No ankle clonus. No varus.

RESULT. Greatly improved. Whereas formerly she was scarcely able to walk she now walks quite well.

No. 11. E. M. Aged 14 years. Spastic hemiplegia. (Right side has been paralyzed since birth.)

June 14, 1915. Cannot raise arm fully above head. Fair power in deltoid and trapezius. Contracture of both axillary folds. Limitation of external rotation. Biceps and triceps have fair power. Wrist is held in extreme flexion of 90 degrees. No active extension, passive extension greatly limited. Arm is pronated and the fingers and thumb are flexed into the palm. Does not use her arm for any purposes. Marked equino-varus of the right foot.

July 21, 1915. Operation, Stoffel's on the right popliteal nerve and lengthening of the flexor tendon at the wrist.

October 25, 1915. Foot is in good position. Walking is much improved. Feeble active extension of wrist and fingers.

December 6, 1915. Uses right hand to dry dishes, can grasp objects feebly with thumb and fingers. Wrist and fingers remain fairly well extended. Slight active extension of fingers.

February 18, 1918. Walks quite well, toes strike ground, but heel touches when bearing weight. Wrist and fingers are flexed and cannot be fully straightened. Active extension of fingers when wrist is flexed.

February 27, 1918. Operation, Stoffel's on median nerve.

March 18, 1918. Passive hyperextension of fingers and wrist is normal. Slight active extension.

April 18, 1918. Wrist and fingers are straight. Has active extension of fingers but none of the wrist.

October 28, 1918. Hand and fingers remain extended. Normal passive hyperextension. Slight active flexion of wrist. No active flexion of fingers. Good adduction of thumb but no opposition. Walks with but slight limp with heel on the floor and no deformity of foot.

March 31, 1919. Active extension of wrist almost to a straight line. Active extension of fingers not quite complete at M. C. P. joints. Good active flexion of wrist but slight active flexion of fingers. Walks well with heel on ground.

RESULT. Walking much improved. Function of hand moderately improved. Appearance of hand very greatly improved.

No. 12. C. C. Aged 9 years. Spastic paraplegia since birth. Did not walk until six years of age.

September 12, 1914. Walks with great difficulty. Walks on toes, and crosses legs.

September 26, 1914. Operation by Dr. Ashhurst, excision of portion of anterior obturators and portion of internal popliteals to the gastrocnemius and soleus.

April 25, 1915. Walks very much better, heels come to the floor but the toes strike the ground first. Knees are flexed and thighs still slightly adducted.

September 26, 1915. Operation, Stoffel's, complete resection of nerves to both gastrocnemii and remainder of anterior obturators.

June 3, 1916. Much better but still marked spasticity of adductors and hamstrings. Heels come to the ground. Walks much better. Father states that he is improved 50%.

August 16, 1919. Walks with knees slightly apart and feet flat on the floor. Has tendency to double pes valgus. He continues steadily to improve, and is walking better all the time. Adductors are well relaxed. Knees are straight, good dorsiflexion of feet.

RESULT. Marked improvement in walking.

No. 13. C. W. Aged 12 years. Spastic diplegia since birth. Was born at seven months.

November 27, 1917. Spastic paralysis of all four extremities. Has never walked. Knees cannot be fully extended. Passive flexion of feet to right angles. Unable to walk even with crutches. Stands on toes, adductors are spastic, knees are held tightly together and can scarcely be separated. Mental condition backward.

February 6, 1917. Operation, Stoffel's, excision of nerves to both heads of gastrocnemii and portion of sciatic supply to solei.

April 12, 1917. Operation, Stoffel's, excision of both anterior obturators and of portion of sciatic supply to the hamstrings.

March 9, 1918. Remained in hospital for five months after operation taking exercises. He now walks with crutches, one foot forward at a time. Feet are flat on the floor, slight tendency to valgus. Knees are held slightly flexed, active flexion of feet to beyond right angle. Extension to about 135 degrees. Knees are well apart in walking, active and passive extension of knees only to 160 degrees.

April 27, 1918. Learning to walk better with crutches. Feet in slight calcaneo-valgus in walking. Knees are flexed and touch each other in walking. Braces applied.

RESULT. Was unable to walk before operation. Now walks fairly well with crutches.

No. 14. D. W. Aged 3 years. Spastic paraplegia since birth. Premature birth at six months. Mother in labor three or four days.

September 16, 1916. Can stand with support only. Marked right equinovalgus, left pes equinus. Stands on toes, adductors slightly spastic. Thighs can be well adducted passively. Knees can be passively extended. Eye grounds negative.

February 20, 1917. Operation, Stoffel's, on both internal popliteals.

September 1, 1917. Has improved considerably in walking. Still walks on toes. Left foot flexes almost to 90 degrees, right foot not so well. Feet are flat.

March 9, 1918. Marked equinus. Walks on toes, heels do not touch the floor. Passive dorsiflexion not to 90 degrees. Braces ordered, to be worn four months before deciding on another operation.

September 21, 1918. Walks fairly well alone, has been improving. Contracture of both tendo Achillis. Right heel touches ground in walking. Left heel does not. Requires another operation.

May 3, 1919. Able to walk with and without braces, when supported by one hand to maintain balance. Can walk without braces without assistance. No adductor spasm. Heels come to floor on walking. Moderate contracture of tendo Achillis, which can be partly overcome by stretching.

October 11, 1919. Able to walk alone. Legs and feet are in good position. Walking is a question of balance.

April 10, 1920. Patient continues to improve. Walks fairly well without braces, but with tendency to pes equinus. Is wearing braces to hold knees in extension.

June 3, 1920. Lengthening of tendo Achillis.

RESULT. Was unable to stand alone or to walk before operation. Now walks fairly well without support.

No. 15. L. V. Aged 3 years. Spastic paraplegia, which followed some illness when four months of age.

September 23, 1916. Lower extremities very spastic. Able to stand on toes when supported. Cannot walk. Mentality poor.

July 31, 1917. Operation, Stoffel's, excision of both nerves to gastrocnemeii, portion of supply to soleii.

May 25, 1918. Feet are straight with no tendency to contracture of tendo Achillis. Good passive dorsiflexion but no active motion. She is able to stand without braces flat on her feet without deformity. Knees are slightly flexed. Adductor spasticity is present.

November 7, 1918. Operation, Stoffel's, excision of anterior branches of obturators, of two nerves to the biceps and one nerve to the semi-tendinosus. Dressed in plaster.

December 6, 1919. Wearing braces, walks fairly well if supported by hand. Knees are well apart but are slightly flexed. There is no contracture of the

hamstrings, the contracture is apparently in the structures of the knee joint. Fair active dorsal and plantar flexion of the feet. Feet in good position on floor.

RESULT. Was unable to walk before operation and could stand only when supported. Now walks fairly well when supported by the hand.

No. 16. J. D. Aged 5 years. Spastic paraplegia since two years of age.

September 15, 1917. Mother states that he has to be carried all the time, and never walks of his own accord. He is able to walk on his toes with great difficulty. Good abduction of thighs.

September 28, 1917. Operation, Stoffel's, on both internal popliteals.

November 3, 1917. Walks fairly well with legs well apart, with heels on floor.

November 8, 1919. Patient has steadily improved until he now walks fairly well alone with feet in good position on the floor, but with his knees slightly flexed. Has good active and passive dorsiflexion. Good passive abduction of thighs. No contracture of hamstrings. Braces applied to correct pes valgus.

RESULT. Walked with great difficulty before operation, now walks well with no deformity except slight tendency to pes valgus.

No. 17. L. S. Spastic paraplegia. March 30, 1918. Stoffel's operation on obturators.

RESULT. Was discharged from hospital improved, and has not been seen since.

No. 18. O. T. Aged 23 years. Spastic hemiplegia. Followed injury to head when eight years of age. Cerebral decompression was performed shortly after the injury, without results.

April 30, 1918. Her right upper extremity is very spastic. The fingers and thumb are flexed tightly into the palm. Her wrist is flexed. Her elbow cannot be fully extended. At times she has rather severe spasms in the muscles of the forearm which occasion considerable pain. She walks with a slight limp but the heel comes to the ground.

May 19, 1918. Operation, Stoffel's, on the right median nerve, resection of about one half of the nerve supply to all the muscles of the wrist and fingers except the F. L. P. and P. Q. and the deep head of the P. R. T., with total resection of the nerve to the superficial head of the P. R. T.

August 13, 1918. Patient has experienced marked improvement. She has good active flexion and extension of wrist against gravity. Can flex fourth and fifth fingers almost to the palm, and the middle finger half way and index finger but slightly. Good active extension of thumb. Can touch thumb to little finger. Rotation of forearm about one-half normal. She is learning to write with her right hand, and is able to shake hands. She goes in swimming and her hand remains straight. The muscles of the forearm are developing.

January 1, 1919. Patient in August of 1918 became severely ill with pneumonia. During her illness the spasticity in her arm became very marked, and her fingers and hand would become strongly flexed. She had severe attacks of pain in the muscles of the forearm, but spasm was at all times more marked

in the ulnar distribution than in the median. Following her recovery from pneumonia the spasm continued. Was still more marked in the ulnar distribution. The patient had lost practically all the improvement she had gained following her operation. She has continued to wear splints to support her arm but at one time had her hand corrected under an anesthetic and dressed in plaster for a time, but her improvement has been slow. She did not begin to get return of voluntary motion of the fingers and wrist for about six months, and she has not yet returned to her condition preceding her illness.

RESULT. This patient had marked improvement in the appearance and function of her hand following the operation, and then suffered a severe relapse which was due to an attack of pneumonia.

No. 19. H. A. Aged 5 years. Spastic diplegia since one year of age.

July 8, 1918. Neither talks nor walks. Mentality feeble. She is able to stand on her feet when supported. Knees are slightly contracted. Crosses her legs when standing. Feet are in a position of calcaneo-valgus.

July 10, 1918. Operation, Stoffel's, on anterior obturators, double subastragalar arthrodesis, and forcible extension of knees.

August 8, 1918. Discharged from hospital and walking on casts.

RESULT. Improved.

No. 20. W. L. Aged 4 years. Spastic paraplegia since eighteen months of age.

July 20, 1918. Right elbow is held flexed. Good power in biceps and triceps. Arm is pronated and there is good power in the grasp and almost normal active extension of wrist and fingers. Drags right leg in walking. Active supination 45 degrees beyond mid-position. He walks on the toes of the right foot. Slight contracture at the knee. Good adduction of thigh.

August 13, 1918. Operation, Stoffel's on internal popliteal.

May 3, 1919. Walks very much better with foot flat on the floor and does not drag toes. Active dorsiflexion of foot to normal extent. No deformity of foot. Fair function of right hand and arm.

RESULT. Fair improvement.

No. 21. C. W. Aged 9 years. Spastic paraplegia. Mental deficiency. Does not talk.

July 27, 1914. Cannot walk alone. Stands on toes with knees together.

August 19, 1918. Is learning to talk. Is able to stand when supported by hand. Contracture of both tendo-Achillis. Left pes valgus on standing.

August 28, 1918. Operation, Stoffel's, on anterior obturators, lengthening of both tendo-Achillis.

December 9, 1918. Braces have been applied, legs are in good position with thighs well apart and knees straight. Patient is learning to walk.

RESULT. Moderate improvement.

No 22. A. S. Aged 22 years. Spastic paraplegia. Had severe paraplegia and had a Foerster operation three or four years ago. As a result of this operation she was greatly improved. Walking much better with her feet in

fair position, with rather marked adductor spasm so that her knees would rub together in walking.

January 14, 1919. Operation, Stoffel's on both anterior obturators. Patient was discharged from hospital about two months later and her walking was very greatly improved. Have been unable to follow this case since operation.

RESULT. Very much improved.

No. 23. D. M. Aged 5 years. Spastic paraplegia, congenital.

January 11, 1919. Has never walked. Is able to stand on his right leg, but not on his left. Left knee is held flexed. Both tendo-Achillis contractured. Marked double pes-valgus. Adductors not spastic. Has marked scoliosis.

January 30, 1919. Operation, Stoffel's, on both anterior obturators, both branches to gastrocnemius, and almost all of bundle to soleus. No contracture of tendo Achillis under ether. Dressed in plaster from pelvis to toes.

February 8, 1919. Lateral traction to spine begun.

August 16, 1919. Discharged from hospital, wearing spinal brace and thigh brace with lock-joint at knees. Able to walk when held by hand. Knees are flexed unless held extended by braces. Practically normal active dorsal and plantar flexion of feet.

June 3, 1920. Walks fairly well without support.

RESULT. Marked improvement.

No. 24. J. G. Spastic hemiplegia. March 22, 1919. Marked spasticity of left arm, and left leg. Able to walk only if held by hands. Walks on toes of left foot.

April 3, 1919. Operation, Stoffel's, on one popliteal.

July 5, 1919. Discharged from hospital walking very much better. Heel comes to ground. Walks without assistance.

RESULT. Marked improvement.

No. 25. A. M. Aged 26 years. Spastic paralysis, spinal. March 25, 1919. Operation on both obturators and popliteals. (Report given by a neurologist Dr. W. B. Cadawallader.) "A. M.'s paraplegia is organic in character caused by a chronic degeneration of the pyramidal tracts of the spinal cord which I think may have followed an infection, but is not syphilitic. The condition has existed for about five years and has progressed but very slowly. She is very neurotic and has had many hysterical symptoms from time to time. Her only chance will be, what you can do, such as a tenotomy—this should help her a lot."

February 23, 1920. When discharged from hospital she was greatly improved.

RESULT. This case has not been followed but showed marked improvement when last seen.*

*Feb. 8, 1921. This patient has been seen a number of times recently. She states that preceding the operation she had been unable to work for five years and scarcely able to walk for three years. She returned to work a month after leaving the hospital, and has worked steadily ever since. She walks almost as well as she ever did, except, when becoming excited, her gait becomes slightly spastic.

No. 26. T. F. Spastic paraplegia. Right arm and both legs. Followed illness when small child.

April 16, 1919. Operation, Stoffel's, on both obturators and tenotomy of left adductor. Also tenotomy of right hamstrings.

July 16, 1919. Application of cast to fractured femur.

RESULT. Case not followed.

No. 27. E. P. Spastic paralysis. Aged 9 years. March 18, 1919. Walks with spastic "scissors" gait, on toes, and with crossing of knees. Moderate spasticity. Ankle and patellar clonus marked. Both legs stiff. Can bend knees when legs are flexed on the thigh, but not if extended. No Babinski.

May 22, 1919. Operation, Stoffel's, on both obturators and popliteals.

October 11, 1919. She has been discharged. She can walk by herself only with the aid of a cane or when held by one hand.

May 8, 1920. Walks readily a half mile without assistance.

RESULT. Moderate improvement.

No. 28. G. P. Aged 7 years. Spastic paralysis. March 18, 1919. Cannot get out of bed by himself, unless very awkwardly. Feet are flexed, adductors spastic. All reflexes exaggerated. Patellar and ankle clonus. Babinski positive both sides. Walks with the aid of a cane and when supported by hand.

May 22, 1919. Operation, Stoffel's, on both obturators and both popliteals.

October 11, 1919. Discharged. Walks fairly well by himself, with feet flat on the floor and without crossing of legs.

RESULT. Marked improvement.

No. 29. S. A. Spastic paralysis. June 26, 1919. Operation, Stoffel's, on both popliteals and obturator nerve.

February 21, 1919. Discharged from hospital improved, but has not been seen since.

RESULT. Moderate improvement.

No. 30. A. S. Spastic paraplegia. July 14, 1919. Parents and three brothers and one sister living and well. Has had paraplegia for three or four years. Stoffel operation four weeks ago, excision of anterior branches of both obturators and nerves to both heads of right gastrocnemius and portion of branch to soleus.

August 11, 1919. Walks better than formerly. Heels to ground and knees slightly apart. Can abduct legs fairly well. Active dorsiflexion of right foot to beyond 90 degrees.

November 24, 1919. Heels do not quite touch ground in walking, due to holding knees flexed. Legs internally rotated. Good passive abduction of thighs.

RESULT. Moderate improvement.

No. 31. M. P. Aged 8 years. July 14, 1919. Spastic paraplegia. Premature birth (between seven and eight months). Cannot talk but is able to copy writing or printing. Able to walk with great difficulty with accelerated gait, walking on toes and crossing legs. Heels do not come to floor.

July 16, 1919. Operation, Stoffel's, on both internal popliteals and anterior obturator nerves. Wounds healed except for small spot in both popliteal incisions. Is already walking better. Referred to nose and throat specialist dispensary for examination for mutism.

December 1, 1919. Heels come to ground in walking. Legs well apart. Gait is markedly improved. Drags toes on walking. Swings legs to side on walking instead of moving them forward. Active dorsiflexion almost to right angle.

RESULT. Marked improvement.

No. 32. D. B. Spastic paralysis. December 4, 1919. Operation, Stoffel's, resection of the anterior branches of both obturators, and of both nerves to the gastrocnemius, one nerve to the soleus and a portion of the nerve to the right tibialis posticus.

Child was able to stand and to walk when held by the hand but she stood

ORTHOPEDIC—EIGHTEEN

on extreme tiptoes with the right foot slightly inverted and the left foot slightly everted. At times her knees would strike together. Mentality seems fair. Her thighs could be separated about one half normal.

December 6, 1919. Good active dorsiflexion of left foot to beyond right ankle and of right foot to about right angle. Good active plantar flexion.

February 23, 1920. Pads have been placed in her shoes to correct the tendency of pes valgus. She walks quite well without assistance. Heels on floor, knees do not strike.

RESULT. Marked improvement.

CONCLUSION

Thirty-two cases have been operated on by the Stoffel method. They have been under observation for periods of time up to six years. No definite relapse has occurred in any. The youngest patient was three years of age, the oldest twenty-seven. Fifteen cases were congenital in origin, eleven infantile, four traumatic, and two were due to spinal degeneration in adults.

No ill results followed operation in any one. Two cases required a second operation. The operations on the popliteal nerve have been almost uniformly successful in relieving the contracture of the tendo Achillis and in enabling the patient to stand and walk with the foot firmly on the floor, and in greatly improving the gait. The operations on the obturator nerve have in all instances corrected the adductor spasticity, which in most of them interfered greatly with walking. The results of the operations on the sciatic nerve for hamstring contracture have also been good. The operations on the median nerve have in all instances lessened

the spasticity or corrected the deformity of the hand. In some instances the improvement in function of the hand was slight or negligible. In other instances it was very great. The hand is such a complex mechanism that it is more difficult to secure return of function when there is marked spasticity, and I feel that the results to be secured here are more uncertain than those to be secured in the lower extremity. The improvement is sometimes more brilliant but I do not feel so confident of it as I do of the results to be obtained in the lower extremity.

Where the patients have been of good mentality the results have always been very much better than where the patients have been backward or feeble-minded. I believe that we may always count on being able to cure any contractures that may be present whether in the upper or lower extremity, and the spasticity may be greatly relieved, but the amount of function, that is, of voluntary active motion of the member, which the patient will secure, depends upon the nature and the severity of the disease, upon the mentality of the patient, and upon the careful persistent after-treatment. In certain cases the deformity is relieved and the spasticity is improved but the patient is unable to establish voluntary control of the member. This, I take it, is possibly due to the organic nature of the disease. In such cases the cerebral control has been definitely and completely lost, either by injury to or disease of the cerebral centers or the cord. Even in such cases the patients are more or less improved by the moderation of the spasticity in the lower arc.

These methods of treatment have been applied to all spastic cases under my observation within the past six years. I believe that the Stoffel procedure is the best single operation which has thus far been proposed because it is applicable to a greater number of cases, the results obtained are more uniformly successful, the operation itself is in no way a severe one, and no ill results appear to follow it. Tendon lengthening is required in some cases and transplantation may be suitable in others; both of which may be combined with the Stoffel operation. It is not to be concluded that the Stoffel neurectomy is a panacea for spastic paralysis, nor that it is indicated in all cases. Judgment must be used in the selection of cases and in the time and application of the operation.

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Frepared by Dr. J. E. M. Thomson, Lincoln, Nebraska.

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News Notes

HOSPITALS FOR DISABLED VETERANS

It is estimated by the Public Health Service that 10,000 additional beds are immediately needed for the hospitalization of disabled soldiers, according to a letter transmitted by Surgeon-General Cumming to a committee of the Senate. The greatest urgency exists in the case of tuberculous and neuropsychiatric patients. On Jan. 1, 1921, there were in the hospitals operated by the Public Health Service 12,511 patients, and in other hospitals under contract 9,781 patients. At present the increase of patients in these hospitals is approximately 1,000 per month, and it is expected that before the peak is reached in 1927 or 1929, from 30,000 to 35,000 beds will be required.—Journal A. M. A.

Dr. Arthur L. Jones has resumed the practice of Orthopaedic Surgery at 737 Schofield Building, Cleveland, Ohio.

The Hospital for Deformities and Joint Diseases of New York City has changed the name of the corporation to The Hospital for Joint Diseases. The change dates from December 1, 1920.

Dr. W. Barnett Owen and Dr. Robert T. Pirtle wish to announce the formation of a partnership practice limited to Orthopaedic Surgery in Suite 400 Francis Building, Louisville, Kentucky.

The Berkshire School for Crippled Children in Pittsfield has recently been given $50,000 by the will of the late Hon. W. Murray Crane.

Dr. John Lincoln Porter of Chicago has an interesting article on the equipment of a Hospital Orthopedic Department in the Modern Hospital for September 1920.

An interesting booklet has been received by the Journal outlining the scope and plans for orthopedic work in Los Angeles. The three organizations: The Hospital School, The Crippled Childrens Guild and The Los Angeles Foundation have been associated for the furtherance of the work. Dr. C. L. Lowman is Chief Orthopedic Surgeon and a member of the executive board.

The nineteenth annual report of the New York State Hospital for the care of Crippled and Deformed Children, has just been received. (Dr. J. J. Nutt is chief surgeon and superintendent.)

The report shows that the Hospital has made considerable recent gain materially as well as in the amount of clinical work being done. 232 patients were treated during the year of which 89 were new. The report is freely illustrated. The fine new building has evidently added considerably to the capacity of the Hospital. At the end of the period for which the report was made, there were 174 patients in the Hospital. There is an apparent inadvertence on page 8, where it is stated that "This hospital is the first state institution of its kind in the country." It is the impression of the editor that the Minnesota State Hospital antedated the New York Hospital by about three years.

The following is one of the post graduate courses offered at the University of Wisconsin in the Extension Department. One lecture and one clinic is given in each subject.

Dr. F. J. Gaenslen—Attending Orthopaedic Surgeon, Milwaukee Children's Hospital and Milwaukee County Hospital.

1. The Surgery of Infantile Paralysis.
2. Static Disabilities with Special Reference to Flat-foot.
3. Chronic Back Strain.
4. Chronic Lesions of the Hip Joint.
5. Tuberculosis of Bones and Joints.
6. Chronic Non-tuberculous Lesions of Bones and Joints.

Current Orthopaedic Literature

A New Explanation for the Formation and Healing of Trophic Ulcers Following Nerve Severance.—Dr. Fritz Bruening, *Zentrablatt fur Chirurgie*, Vol. 47, No. 48, Nov. 27, 1920.

We are accustomed to the appearance of the so-called Trophic Ulcers after the severance of nerves or severe injuries. The author hopes to show that the stimulus of scar tissue to the proximal nerve end can be considered as a causative factor.

While on duty in Turkey he observed two very similar cases of gun-shot injuries of the Ischiatic nerves. These injuries had occurred many months before. Besides the muscular lameness there occured very marked trophic disturbances, in sense a venous hyperaemia with large and deep ulcers which went down to the bone. These ulcers up to this time had been resistant to all forms of treatment.

After this length of time it was barely possible to expect a functional result after nerve suture. However, he performed a nerve resection and suture. Almost immediately after the operation the trophic disturbances began to subside and in four weeks these large deep ulcers were smoothly healed. A further six months observation showed no functional result.

The result in these cases was unexplainable to the author until he read the article by Leriche in No. 29 of this journal which seemed to aid him in giving the necessary explanation.

He explains the condition as follows: Through the formation of the neuroma and pressure of the scar upon the nerve there is a stimulus from the proximal end of the severed nerve to the sympathetic which disturbs its tonus. With the operative removal of the neuroma and scar the stimulus is removed and its normal tone reappears and the trophic disturbances disappear.

The rebuilding of the nerve continuity serves the purposes that it hinders the reformation of a neuroma and dense nerve tissue and of course it gives the possibility, also, that a functional result may return.—*K. S. J. Hohlen, Lincoln, Nebraska.*

A Rare Case of Malformation of the Toes in Both Feet. (Syndactilism and 13 toes). *By A. Stoffel.* Fortschr. d. Roengenstr Bd 26. Heft 3 S. 270.

Patient is a 19-year old healthy and well developed sailor whose disability consists in pain in the feet when walking and standing and who is not able to wear shoes without discomfort.

Upon examination is found that patient has on the right foot two normally developed little toes and two big toes the skin of which is grown together; but there are two separate nails; on the left foot there are two perfectly developed

little toes. The forefoot is on account of this abnormality very much broader than usual. The Xray shows: On the left side six apparently fully grown metatarsals and six toes with the three phalanges; on the right foot are seen five metatarsals with enlarged articulating surfaces on the first and fifth metatarsal bones for the articulation of the supernumerary toes.

Operation was performed on both feet for the removal of the toe with extirpation of the metatarsal on the left foot; and for the amputation of the little toe and removal of the lateral half of the big toe with part of the articulating surface of the metatarsal bone on the right foot.

Functional result follows the operation.

Etiologically it is of interest that the patient's father and grandfather had similar malformations.—A. *Gottlieb, M. D., San Francisco, Calif.*

CENTRIPETAL MASSAGE OF SCAR TISSUE. *By A. Szenes.* Wiener Klin. Wochenschrift. 1919 No. 28.

By means of forcible separation of the skin surrounding the scar and of the scar tissue itself from its bony base, the author succeeds to form small folds. The separation is performed by means of the thumbs centripetally towards the centre of the scar. After two or three sittings, the scar becomes hyperaemic and slightly inflamed. Through this inflammatory oedema of the scar and surrounding tissues, the nonelastic fibrous scar becomes more yielding and soft, more folds begin to form until, finally, the scar can be lifted from its base to which it was adherrent.

This massage is not contraindicated in cases with small wounds in the centre of the scar as it frequently is found in amputation stumps; on the contrary: this procedure stimulates the wound to better healing.

Especially is this method of loosening scar applicable when bone forms the base; while upon muscles or fat as a base, the result is not as favorable, because of the mobility of the base.

Hot air exposures and passive hyperaemia artificially induced are used in conjunction with this massage treatment, which is very valuable as a preoperative measure to gain more skin for the subsequent closure of wound.—A. *Gottlieb, M. D., San Francisco, Calif.*

ENDOTHELIOMA OF THE CAUDA EQUINA. Idris Morgan and Alan T. Roberts, *Med. J. of Australia,* Vol. 11, No. 24, p. 533.

The case described is that of a male 46 years of age whose principal complaint for the past three years had been "lumbago and sciatica." For the past 3 or 4 months he has had increasing weakness of the legs and tendency to incontinence. Diagnosis was made from the following data:

1. Incontinence of urine and feces.

2. Complete anesthesia of skin areas supplied by lost lumbar and upper sacral nerves.

3. Absence of knee jerks, plantar and ankle reflexes.

4. Complete loss of movement from ankle down—foot drop.

No X-Ray was made. Because of the progressive intensity, operation was performed, having been localized as being in the region covered by the 5th lumbar vertebra.

The laminae of the 2nd, 3rd, 4th & 5th lumbar vertebra were cut, arch removed. The dural contents seemed constricted. An incision was made in the dura and adenomatous mass easily separated from the cauda was removed and incision closed. Pathologists reported the tissue as there was early return of voluntary movements in both legs, and control of dural and visual sphincters.—*James E. M. Thomson, Lincoln, Nebr.*

RIB GRAFTING OPERATIONS FOR THE REPAIR OF BONE DEFECTS AND THEIR END RESULTS AT LETTERMAN GENERAL HOSPITAL. San Francisco, Leo Eloesser, *Arch. Surg.*, Nov. 1920.

The authors series comprises 22 cases. This type of graft appears more appliable to skull and face plastics, where little strain is brought to bear on the graft. In the repair of large defects they are prone to refracture, as occurred in seven out of the 22 cases. They seem very viable even in the presence of suppuration when they survive more often than larger grafts. Thirteen cases were successful, six partially successful and three were failures.—*James E. M. Thomson, Lincoln, Nebr.*

THE AFTER TREATMENT OF DISLOCATION OF THE ELBOW. Ernest T. Saeger, *Boston Med. & Surg. J.*, Nov. 4, 1920.

According to Dr. Saeger's statement there is greater tendency after injury to the elbow joint for osseous proliferation in neighboring muscles than in the trauma of any other joint. For this reason early passive motion and massage after dislocation are contra indicated.

The origin of this new bone formation is by tearing of the periosteum and the wandering proliferation of osteoblastic cells in the muscular tissue or by metaplasia of the connective tissue of the capsule or intermuscular septum.

The arm is kept immobilized or broken up under anesthesea, this long period of fixation renders the development of myositis ossificans traumatica less likely to occur.—*J. E. M. Thomson, Lincoln, Nebr.*

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HALLUX VALGUS, RIGIDUS AND MALLEUS*

BY PROFESSOR MARK JANSEN, LEYDEN

Hallux valgus, rigidus and malleus may occur separately, but very often they are associated. And in the combined conditions each may occur in the most varied degree.

Two principles make themselves felt in these deformities: 1° disturbance of muscle balance, which is most prominent in hallux valgus; and 2° joint wear, the arthritis deformans of text books. It is most prominent in hallux rigidus.

Hallus rigidus is due to extra strain upon the first metatarso-phalangeal joint. It is apt to develop in people with slightly everted foot, in which the line of gravity in walking passes nearer the first metatarsal than normally. Hence in people with muscle weakness, especially those who have outgrown their strength, i. e. the type of slight feebleness of growth. Their feet and hands are as a rule moist, blue and cold. The characteristic flattening of the metatarsal head with gradual shortening of this bone, the lipping, the thinness of the joint cartilage, the vascular tissue below the cartilage and in the synovial membrane are well known. The lipping causes pain from pressure in walking mostly on the plantar side, which contraction of the flexor brevis tries to forestall. The overexertion of this muscle leads to its permanent involuntary contracture. Thus hallux malleus develops which, however, may also occur without primary hallux rigidus by cramp of the flexor brevis hallucis. The malleus position is apt to cause the abductor hallucis to slide downward and thus to strip it of its abduction power. When the adductors prevail, hallux malleo-valgus very frequently evolves.

*A paper read at the meeting of the British Orthopaedic Association, June 4th, 1920.

Hallus valgus is in most cases the generally acknowledged effect of too narrow or too pointed shoes, especially when high heels are worn with them. Not everybody who wears such shoes gets hallux valgus. Luxation of the extensor proprius and flexor longus hallucis is needed. Thus relative hard pull on these muscles is required. This is in harmony with the fact that frequently hallux valgus is attended by hallux rigidus. The pull of these luxated muscles causes the widening of the region of the metatarsal heads, especially the enlarging distance between the 1st and 2nd.

The osteophyte and the bursa mucosa with the characteristic reddishness which develops, denote the progressive stage into which hallux valgus gets by the luxation of the above tendons. The abductor hallucis, when losing its abducting power by displacement towards the planta, thus introduces a second disturbance of muscle balance. The valgus condition is then combined with malleus, which is shown by the callosity on the plantar side of the inter-joint of the big toe. Hallux valgo-malleus has developed. In this condition the valgus element prevails, whilst in hallux malleo-valgus the malleus part forms the outstanding feature. Moreover in this condition the metatarsal heads are less wide apart.

From the above it follows that well fitting shoes and raising of the inner border may largely contribute toward preventing the development of these conditions.

Therapy should be directed both to muscle balance and joint wear. The transplantation of the abductor hallucis has proved useful to me. In not light cases it may be combined with shortening of the 1st metatarsal according to Ludloff's method or by the removal of part of the metatarsal neck. I should much like to hear the results of your vast experience on the removal of the metatarsal head.

Discussion

Mr. Trethowan: The condition of hallux rigidus may, of course, be due to different causes; there is the one class that is due to accident; other cases are due to acute infection of the big toe joint; subacute rheumatism is very common, I have had a great many such cases, all young people. That is one form you must not touch. If it is a rheumatoid condition, you must not attempt to touch it.

The conservative operation would seem to be to take out a wedge behind the joint. Don't open the joint more than you can help. Take out just so

much wedge as will enable you to break the toe. That gives an immediate result lasting six or twelve months; ultimately they tend to go back.

MR. ELMSLIE: Every one of us operates on Hallux valgus and Hallux rigidus, and I would like to say I believe I have tried everything for these conditions, including removal of wedges, transferring of extensor pollicis, transferring of adductor pollicis, and complete excisions, and I have absolutely no hesitation in saying that there is only one successful operation for hallux valgus, and that is, complete removal of the head. It is a most satisfactory operation, if we do it in the right place and of course treat the patient afterwards properly. You have got to take every step afterwards to get the neck of the first metatarsal into the proper line. It is a most satisfactory operation. Of course we all have failures, but I must say I have not met many failures myself. I have had patients come back to me, and they are able to do practically everything that a normal person can do. I have no hesitation in saying that full excision of the head right down to the neck, is a very successful operation.

I have not often tried transplantation of the abductor pollicis, it seems such a rational thing to do, particularly in young people. I have done it, but I was disappointed with the ultimate result.

I have also tried wedges, but they have all relapsed, and I have now got to the stage that I won't do anything but a full excision, and personally, I am satisfied with the results.

MR. ALWYN SMITH: I think there is something in what Mr. Trethowan has said. I have tried everything—they do fairly well, but my bugbear is the hallux rigidus flexus, the man who cannot walk, in which case you have to take away the head of the bone.

We don't get the simple relapses now that we sometimes used to get. As long as they are walking on the level they do quite well, but I have one case of a man who comes complaining that, after fishing all day, he finds he cannot jazz all night. . . . As regards this operation I take the mid line between Mr. Elmslie's hyper-optimism and Mr. Trethowan's pessimism.

MR. AITKEN: I think I should like to agree with Professor Jansen as to the pathology of this condition. It seems to me that one has got to look at hallux rigidus flexus as a part of what is a "flat foot" deformity . . . . In the case of elderly people, who come with painful great toe joints, with a certain degree of hallux valgus, you generally find that the whole arch has fallen inwards. I take it this way. When you are getting extra strain on the foot, and the arch is tumbling over, the patient makes a great effort to keep that arch up, there is long continued overwork of the great toe, which leads in time to changes due to teno-synovitis. I think it is this constant balancing strain on the inner half of the foot that is in this case responsible for the painful great toe. Therefore, I will not undertake the treatment, operative or otherwise, of this case, unless the patient will consent to have the whole thing treated as one condition. The important point is to get the full breadth in the fore part of the boot, so that there is room for the patient to spread his toes. You must get the inner side of the arch well thrown up. Often the great toe has been overlapping the side of the sole of the boot; the middle of the arch is down, the great toe joint is swollen; and the sole is too narrow.

MR. DUNN: As regards these patients who come complaining of pain. This is not always associated with limitation of movement in the joint. Very often the cause of the pain is some exostosis on the metatarsal, and the pain is due to pressure between that and the boot, and all that is necessary in these cases is to trim the metatarsal ridge and remove all the prominent bone, so that the foot fits the boot. We very often came across these cases in the Army, as a result of wearing Army boots, and the only thing necessary was to remove the exostosis so that they could wear the Army boots.

As regards limitation of movement in hallux valgus, the pain in the joint is here also due to exostosis and pressure. Trim the metatarsal head, leaving the under surface for weight-bearing—remove a good half of the base of the proximal phalanx. Get rid of the exostosis and thus allow free movement, leaving a good weight bearing surface.

There is one other condition. If the condition is associated with fixation of the sesamoid bones to the metatarsal head, you are apt to get corns on the weight bearing portion. I think in this case the sesamoid bone should be removed and the undersurface of the metatarsal levelled.

Mr. Bennet: I know of one Surgeon who trimmed the head of the metatarsal and so prevented any pressure, but he had so many recurrences that he adopted, at my suggestion, the other method of simple excision of the head of the bone. In my opinion, excision of the head of the metatarsal bone is most gratifying, and I know of no other operation for that condition which anything like touches it.

Mr. Leaming Evans: In an advanced case of hallux rigidus I know of no better operation than an excision of the head I did one some years ago on a postman, and I know this man has carried out his duties, walking his rounds of eighteen miles a day, with the excised head.

As regards the operation, I usually open the joint by a dorsal incision, expose the head, and look at the cartilage. If there is lateral exostosis and the rest of the head has got a good cartilaginous surface, I remove the exostosis: if the rest of the cartilage is diseased, I remove the head. I am an optimist on both of these operations. I have traced a good many of the cases, and the exostosis does not recur. As regards excision of the head, the thing that has frightened me is that "kicking up" of the toe after excision. . . . I would like just to mention I have only had one case of the removal of the base of the phalanx, and in that case I had to do an osteotomy afterwards. Personally, if I am going to remove the head, I remove the whole of it. The disadvantage of that is that the extensor tendon is apt to overcome the flexor, and, in order to obviate this, I free the under surface of the remaining part of the metatarsal, remove the head and neck fairly freely along the plantar surface, and allow the free surface of the bone to slide easily up and float on the sesamoids. I believe that obviates that "kicking up" which is such a disadvantage. As a confirmation of my statement that excision of the head gives a good result, I have a letter here from a patient in whose case I removed both heads. I may say that the patient was an Army Officer, and not at all a man who was easily satisfied, and he writes "I am exceedingly pleased with the result of the operation."

Sir Robert Jones: We have had a most interesting discussion. . . I have had a series of cases in which I took out a wedge just behind the head of the bone, but the results were not always satisfactory, and, although one is always prepared to listen and to try, I have come back to the firm conviction that the most satisfactory operation is complete removal of the head. . . . It is important to recognise that this is only part of a general condition. The operation of removal of prominences one has done often, and the point of interest about that is that, after removing them, you have to remember you may find the trouble intensified later on.

CONGENITAL TORTICOLLIS*

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Torticollis of congenital origin is a deformity rarely met with in the general practice of medicine and surgery. Only twenty-six of more than 212,000 patients examined in the Mayo Clinic from January, 1910 to October, 1919, had a diagnosis of congenital torticollis and operation. The average age of these patients was 17. Twenty-three of the twenty-six had had no previous treatment. The rarity, lack of, or inadequacy of the previous treatment, together with the advanced age and marked deformity appear to warrant an investigation and report of results. Torticollis of the spasmodic, rheumatic, and spinal caries types is not considered in this study.

The deformity presents a characteristic picture, varying somewhat with the age of the patient. The sternomastoid muscle may be enlarged soon after birth and the head drawn slightly toward the affected side. As the swelling subsides the muscle is contracted to a tense and hardened cord, the head is drawn further toward the shoulder and the chin in the opposite direction. The rotation and contraction soon produce a scoliosis of the cervical spine, the shoulder is narrowed and raised in an attempt to hold the head in a perpendicular line, and a compensatory scoliosis develops in the dorso-lumbar area. Distortion of the face results and the muscles, fasciae, and even vertebrae may become deformed if the condition is not relieved. Changes in the visual field, and thoracic, spinal, and pelvic deformity may occur (Fig. 1).

The etiologic factor appears to be trauma to the sternocleidomastoid muscle at or preceding birth, producing an ischemia with resulting chronic interstitial myositis. The ischemia may result from pressure upon the sternomastoid branch of the superior thyroid artery or from a hematoma into or around the sheath of the muscles affected. Heredity, infection, and syphilis do not seem to be factors. Impaired circulation has been ascribed as the cause of torticollis, but I believe that the lack of normal impacted stimuli

*Submitted to the American Orthopedic Association, June, 1920.

transmitted through the osseous system is an important contributing factor.

Eight of our patients had been traumatized at birth, five by the use of forceps or by unusually long and difficult labor, two in breach presentations, and one in transverse presentation. One ascribed the cause to injury soon after birth. Seventeen gave no

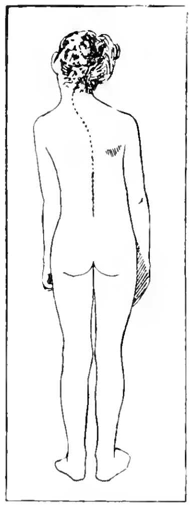

FIG. 1. Posterior view (tracing of photograph) of patient aged 12 with congenital right torticollis and scoliosis. This patient had marked facial distortion (Fig. 2). The right shoulder appears wider from the posterior aspect.

definite cause for the condition or history of trauma. Since the ages varied from four months to twenty-eight years details with regard to the injuries at birth were extremely difficult to obtain.

The diagnosis presents little difficulty. A painless contraction of the sternocleidomastoid muscle, easily palpated and not tender, produces the characteristic deformity, in which the mastoid is drawn toward the raised and narrowed shoulder on the side affected and the chin forced in the opposite direction. (Fig. 2).

In the differential diagnosis, Pott's disease, infection with myositis and perispondylitis, spasmodic torticollis, fracture of the spine, and syphilis are considered. *In tuberculous disease* of the cervical spine there is a general muscular rigidity with pain, especially on jolting, and as the disease progresses the patient supports his head on his hands. The symptoms are more severe and the temperature rises in the afternoon. In the late stages the destructive process may be demonstrated by the roentgenogram. The von Pirquet test may be of value, especially in children under 5. Infections giving rise to torticollis produce a more general muscle involvement with pain, tenderness, local edema, higher

FIG. 2. Tracing from photograph (Fig. 1) showing distortion of the face. The measurements show the right side to be three-fourths inch smaller than the left.

temperature, evidence of sepsis, and acute adenitis, and though the deformity may be fairly typical it rarely accurately represents the congenital type which is usually painless and without a rise in temperature. In the late stages with perispondylitis fixation of the cervical spine may take place without persistent pain and the deformity be quite typical, although palpation fails to demonstrate a spasm in the sternocleidomastoid and a fixed spine that can be demonstrated clinically and sometimes roentgenographically. *Spasmodic torticollis* occurs usually in middle life or later; it is functional and is found in neurotic, overwrought persons of impaired nerve power. The spasm is easily overcome temporarily but recurs as soon as the force is released; there is little or no pain be-

fore, during or after the manipulation, which is not true of the congenital type. In *fracture of the spine* pain in later life and the roentgenographic findings are characteristic and may be readily differentiated. *Syphilis* presents many varied manifestations of the deformity, although a careful history, a clinical examination, and serologic findings should reveal the true cause when this possible etiologic factor presents itself. *Congenital deformity of the vertebra* may be encountered, as was the case in one of the patients included in this series. The spine should be x-rayed in all cases in order that an accurate prognosis may be given.

The treatment of congenital torticollis is surgical. Although manipulation may be of some benefit, this prolonged and painful procedure has so little to recommend it that it has long been discarded. Surgery offers a rapid, safe, and certain method of relief, with a minimum of pain and discomfort. It is our practice to urge surgery as early as possible. We divide all contracted structures, over-correct the deformity and maintain the new position by means of plaster casts. Unless the patient is seen in the early stages subcutaneous tenotomy should be avoided, and even early it is attended by the danger of hemorrhage and incomplete operation. The sternoclavicular route is preferable to the mastoid, although the scar from the latter is less noticeable because of the covering of hair. The Mikulicz operation of removing the lower two-thirds of the sternocleidomastoid and the cervical fascia leads to the danger of damaging the spinal accessory nerve and vessels and has not been found necessary in any of our cases.

Technic of Operation

An incision just above and parallel with the clavicle at the sternal end is made through the skin and platysma myoides muscle and superficial fascia. Blunt retractors expose the contracted and cordlike sternocleidomastoid muscle which is dissected free from surrounding structures by blunt dissecting scissors and divided, or a portion an inch in length is excised for pathologic examination. An assistant turns the chin toward the affected side and pulls the head in the opposite direction; if there are any contracted structures they are thus brought into prominence and then divided. Usually division of the superficial fascia, platysma, and portion of the deep fascia is sufficient, and with good exposure there is little

danger of injury to the jugular vein, pneumogastric nerve, and carotid artery. When all contracted structures are divided there is little or no resistance to overcorrection. The wound is carefully sponged and all bleeding points are ligated, leaving a dry wound. If possible a few sutures are placed so as to aid in the obliteration of dead space and the wound is closed with silk worm and a fine dermal suture; if the platysma is much contracted no attention is paid to its approximation. A pad of gauze and cotton is placed over the wound and held firmly in place so as to aid further in the obliteration of the cavity. A cast maintains the corrected position. If scoliosis has resulted from long standing postural deformity the patient is placed in extension the day before operation and a cast applied from the pelvis to the axilla. This allows greater ease in fixing the head and shoulders when the patient is under anesthesia and permits of the correction of the curvature in most instances. When the fixation is complete the shoulder on the affected side should be held down firmly with the chin pointing toward it and the head forced well over in the opposite direction. The patient readily becomes accustomed to the corrected position and is held practically free from pain in a retentive apparatus not easily moved. The length of time in the fixation cast varies with the degree of deformity, usually from one to three months, after which the scar has little tendency to reproduce the deformity by contracting. A window should be left over the trachea in all cases. Because the habit of holding the head in the torticollis position if not easily overcome the plaster fixation is very satisfactory, although all patients are instructed to exercise before a mirror after the cast is removed. At times a bag of shot carried in the hand of the affected side is of value in correction. In some of the less severe deformities stretching by extension and active motion following operation may be sufficient, but I believe that long standing deformities, such as are observed in this Clinic, require retentive dressings in overcorrections.

Eighteen of the twenty-six patients operated upon were heard from. Fourteen reported that they were cured and four much improved. The age of some of the patients and the lack of previous treatment were responsible for deformity which even the reposition of the head in normal balance and poise cannot overcome, especially if the patient's full growth has been attained. It is well to have the patient understand this, and that if he has any facial

deformity, it will be accentuated, at least for a time, and in adults will probably be permanent. In children with distortion excellent facial recoveries are obtained.

SUMMARY

Congenital torticollis is a deformity not commonly met with in the general practice of medicine. The deformity is characterized by a practically painless, contracted cordlike sternocleidomastoid muscle, which pulls the head toward the side affected, narrows and draws the shoulder upward, forcing the chin in the opposite direction. The etiologic factor appears to be trauma at or preceding birth. Permanent deformity may be prevented by early treatment. The treatment is surgical and retentive apparatus is advisable (Fig. 3).

FIG. 3. a. Contracted prominent left sternocleidomastoid with raised shoulder drawn upward to the affected side of the head; the chin is turned in the opposite direction. The right eye is held higher than the left and the face is distorted. b. Posterior view of the shoulders and neck showing raised shoulder previous to operation. c and d. One year after operation, the head and shoulders were practically in normal position although the facial distortion is apparent. The right eye is noticeably higher than the left.

Simple Congenital Torticollis

Case 89220. A boy, aged 12, came to the Clinic August, 1913, because of a wry-neck. He was a second child and had had an apparently normal birth. His head was drawn toward the right shoulder and the deformity seemed to get worse as he grew older.

At operation August, 1913, the contracted sternocleidomastoid was divided. Six and one-half years later the patient's condition was apparently normal.

Complicated Congenital Torticollis

Case 199771. A young woman, aged 21, came to the Clinic July, 1917, because of deformity of head and neck. The examination revealed a tight cord like sternocleidomastoid, the head drawn down and the shoulder up, the chin being forced towards the opposite shoulder. There was marked distortion of the face, the left side was smaller, and the eye lower. Scoliosis was present.

A roentgenogram of the spine showed a congenital deformity of the fifth and sixth cervical, and second, third, and fourth lumbar vertebrae, and bilateral cervical ribs, the right being large. The prognosis was guarded because of the complication but operation was advised. The contracted sternocleidomastoid and fascia were divided and a plaster of Paris cast applied. The result of the operation was satisfactory, the patient reports herself cured.

THE CURATIVE PLAY SYSTEM OF THE CHILDREN'S MERCY HOSPITAL OF KANSAS CITY, MISSOURI.

(A preliminary report.)

DR. R. McE. SCHAUFFLER, KANSAS CITY, MO.

Just acknowledgment has been made by the Scientific World of the valuable contributions of Orthopedic Surgery to the War Problems. The interest and enthusiasm of the laity has been aroused by Reconstruction Work. In the operating room, in the physiotherapy department, in the gymnasium and in the work shop, it has justified itself. Orthopedic surgeons have been prompt to call attention to the need of applying these reconstruction lessons to the problems of the crippled child, the physically deficient, and to those disabled in industry.

My purpose is to direct your attention to one largely undeveloped field in the program of reconstruction for children.

In the Spring of 1919, Dr. Katherine B. Richardson, of the Surgical Staff of the Children's Mercy Hospital, suggested to the writer that we should attempt to direct the play of the children in such a way as to help them overcome their physical disabilities. As an outgrowth of this suggestion, a plan has been worked out which we have christened, "The Mercy Hospital Curative Play System." The two words, "Curative Play" are each significant. It must have a direct therapeutic purpose. It must be made fun; must appeal to the child's love of play and to its desire to imitate others, and to compete with them.

In the literature of recent years the value of active exercise over passive has been frequently noted. Attention has also been directed to the fact that repeated earnest efforts of the will seem to have an effect in reviving nerve centers not quite completely destroyed, or reopening tracts not quite hopelessly blocked, when more casual efforts have failed. These facts have been borne in mind and this system invites active exercise under the stimulus of enthusiasm within limits set by a scientific observer.

Treatment is definitely prescribed by some member of the Surgical or Orthopedic Staff, for each individual child. An accurate, detailed diagnosis is put on the patient's card; the percentage of strength in partly paralyzed muscles, the range of motion in joints, and the degree of deformity, are recorded before the treatment is begun. It is necessary to specify what parts of the body may be used without protection, what need partial protection, and what parts must be completely protected.

With many children, in the first weeks of the treatment, the work must be individual. It may begin on a gymnasium mat in the corner of the ward. The teacher is down on the floor with the patient, and the procedure has some of the characteristics of a mild romp or a game, although it could not properly be called play at this time. The next stage may be individual work with the child in the gymnasium with the aid of some simple apparatus. Then two or three children are grouped together; the scene is shifted to the play room, or out-of-doors, and the same types of exercise are worked out in a game.

Massage and electricity, heat and light, and passive motion may, any or all of them, be indicated for the child at the same time, and contribute their part to improvement. We must not claim all the credit for curative play, but try to appraise its addition to the results in larger benefits. Those cases nearly at a standstill under the other methods, afford us the best opportunity to appreciate it's advantages. To pass to an individual illustration: Here is a small boy, bed or wheel-chair ridden for years, where initiative for locomotion is apparently gone. He is lonesome when the other boys go to the dining room for meals, while he has a tray in the ward. One day he climbs onto another chap's kiddie car and manages to pole himself along with one leg, to the dining room. The earnest desire to trail the bunch has been more effective than any exhortation of doctor or nurse. With the kiddie car comes the need of a scientific oversight. Does the boy, with adductors already overstretched, cross the foot over the car and ride with this limb in exaggerated abduction? It is good for him to ride, but he must be taught to sit and so propel himself as to gain the maximum benefit, and not make anything worse. It is a short step

to having a kiddie car race between two cripples. The next step is to have the boy propel himself and, in addition, push or kick a ball with one foot. It will depend on his lesions as to which foot he does most of the propelling with, and which foot is used to strike the ball. Two or more boys at a game of this sort, with some sort of objective or goal, and we have "kiddy car polo."

Let us take another illustration: Here is a boy with almost complete dangle legs and marked loss of power in the lower back and upper thigh muscles. As you know, there is almost always some latent power remaining in the upper part of the limb. The child cannot possibly walk with braces, for he has not enough power to advance the splinted limbs, or to prevent a backward flop of the buttocks. Our first efforts are directed toward developing these muscles, the patient lying on his back. Then the boy is encouraged to kneel on a padded table, with his arms through the swinging rings, and to try to walk on his knees. It is more fun if he is traveling between low parallel bars over a gymnasium mat and another boy is trying to do the same thing at the same time. Suppose next, the boys are in a sand bag trench and are expected to shoot with a toy gun. At first the boy must lean on the parapet. The day that he can kneel free and hit a mark with the gun he is strong enough to be able to begin to learn to walk with braces. Thus, we have the "Trench Game," or the "War Game."

We have at Mercy Hospital a teacher who has been trained in physio-therapy and has had the practical experience of a Reconstruction Aid. She devotes her entire time to Curative Play. The expenses are paid by the Children's Relief Association of Kansas City, and this summer a small group of volunteer workers will assist the Play Teacher.

Most of the work is done in the gymnasium, or in a specially equipped play room, or out-of-doors, where we have arranged some simple apparatus on the lawn. This spring and summer we are planning to build a large play ground just as definitely planned for Curative Play as a country club is laid out for tennis, polo and golf.

The equipment, in addition to a well furnished gymnasium, includes:

Kiddie cars,
Rubber and wooden balls of various sizes,
Jacks and marbles,
Bean bags and target pockets,
A ping-pong outfit,
Building blocks,
Large sand bags for parapets,
Toy guns,
A captive tennis ball and raquets,
Wig-wag flags;

These require no comment; their uses will naturally suggest themselves.

In addition I want to call attention to some more special features:

(1) A platform for signalling, with three pairs of stairs leading to it; (a) with average steps for children, (b) with high steps to force stiff hips and knees, (c) with very shallow steps for paralyzed cases.

(2) Two sets of fixed parallel bars, long and rather low, for walking. These have proved very useful as, even if the hands are not used, the side bars give the feeble walker confidence. Two sets provide opportunity for competition. Low movable, parallel bars for support in walking on knees.

(3) Punching bags, so hung as (a) to be struck by the fists, (b) to be kicked, (c) to be kicked upward with patient lying on back on a mat.

(4) Velocipedes, with slipper pedals.

(5) Mechanical toys, with key wind, some forward, some backward; others with a windlass wind.

(6) Balloon bags for inflation.

(7) Vaulting horses, or a sort of gymnasium hobby horses, with varying size barrels and stirrups, adjustable and removable. These are valuable for two opposite types: To stretch scissor legs, and to strengthen a weak grip of the knees.

Some plays require no apparatus. After a certain stage of quiescence is reached, children with Pott's disease seem to be benefitted by quadruped games. As long as they do not sit or stand, but run about on all fours in some animal game, there is no tendency to increase deformity and they improve more rapidly for the exercise.

This work was begun under unfavorable circumstances because it was largely confined to In-Patients in the Orthopedic Division. Many of these were badly diseased or desperately paralyzed and required many weeks, or months, of patient preliminary treatment by the teacher before they were ready for anything like a real game.

With the advent of warm weather we will have many out-patients, who will furnish more favorable material. It is proposed, later, to allow crippled children to come, just for play, provided they pass through the Dispensary, and, after complete examination, the types of play are prescribed by the Orthopedic Surgeon.

Forty-one cases were referred to the Play Teacher, between Nov. 15th and April 1st. These included fourteen old Infantile Paralysis cases, mostly dangle legs; six cases of Spastic paralysis, with rather severe limb disability, but of fair mentality; nine Spinal cases; seven cases of impairment of one or more extremities, due to inflammation; and five foot deformities.

Of these forty-one cases, eleven have been under treatment too short a time, or have been to irregular in attendance to be considered in this report. Of the thirty remaining cases, five were not improved; eighteen were moderately improved; and seven were greatly improved.

It is obvious that it has been a great advantage to have a trained person whose whole time was available for work for the improvement of function in the various types of deformity or disability. The improvement of some cases, such as one bad lateral curvature, could have been equally well attained by corrective gymnastics, without any camouflage of play. Upon analyzing the cases to see in what proportion the play element seemed a vital factor, we find it seems to have had a specific value in nine of the eighteen cases moderately

improved, and in three of the seven cases greatly improved. The others are a credit to the teacher, but no proper argument for curative play per se.

The writer of this paper has not forgotten the criticisms made at the last session of this Society on the reports of Curative Workshops, namely: That much was said of the organization, equipment and methods, but in most cases it was not proven that the work cured, or was the main cause of improvement. To support my contention, I must show that curative exercises, prescribed by the orthopedic surgeon, and supervised by a special teacher, by being made attractive by the choice of apparatus, by the introduction of competition and by the final submerging of the exercise in real play, have a therapeutic value not otherwise obtainable. I propose to report cases and results in detail after the method has been a complete try-out, and let it stand on its merits.

It has always been a cardinal principle in Mercy Hospital not to repress the spirit of childhood. There is plenty of room. The very sick children and those who need quiet are by themselves. We give the children a great deal of liberty. There has always been a school room and a play room, and toys and little entertainments. But with the advent of the Play Teacher I note a new interest in the lives of the children. Lethargic cases are waked up, and discouraged ones are heartened. The normal activities of the more vigorous are directed with a therapeutic purpose. A number of children show an improvement which we have not attained by other methods.

Because of these encouraging features, I have ventured to intrude on your attention with this preliminary report of Curative Play.

REPORT OF A CASE OF LOOSE OSTEOCARTILAGINOUS BODIES IN THE KNEE JOINT

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Osteocartilaginous bodies in the joints is not a rare condition, but the case under discussion is a rare type. It is reported because of this rarity and because of its association with a mild hypothyroidism.

Case 26042. Miss W. F. C., aged 35, came to the Clinic July 10, 1909, with symptoms of exophthalmic goiter. The superior thyroid vessels were ligated. Following this operation her general condition improved greatly. September 28, 1920 she again came to the Clinic complaining of trouble in both knees. Eleven years before she had sustained an injury to the right knee following a fall from a chair. The knee became swollen and painful and completely incapacitated the patient for two weeks. She had difficulty in fully extending the knee after being seated for some time. Walking upstairs caused a catch in the knee which disappeared by gentle manipulation. During 1916 about once a month if the knee was kept flexed for a long time it locked, producing pain, swelling, and loss of function for two weeks. By rest in bed the patient was able to straighten the leg completely. In September, 1920, she had a sudden onset of pain and locking and swelling of the other knee without any apparent cause. She had had acute tonsilitis and influenza on several occasions and when a child she had had scarlet fever complicated with general arthritis, especially in the knees and feet.

At the time of examination the patient weighed 140 pounds and was 5 feet 3 inches tall. A distinct hypofunction of the thyroid gland was manifested by a slight puffiness of the face, dry skin, and dry brittle hair, and a basal metabolism of -10 per cent. The pulse, blood pressure, and temperature were within normal limits. There was a slight secondary anemia; the leukocyte count was normal and the Wasserman test negative. The tonsils were graded 2 on a scale of 1, 2, 3, and 4. Pus and a periapical infection were observed around one tooth in the roentgenogram. The

kidneys were normal. The knees were normal in appearance, but leathery crepitus could be elicited on motion in both knees. Extension was complete, but flexion was possible to a little less than a right angle. Roentgenograms of both knees showed marked destructive processes in the condyles of the femurs and to a less extent in the articulating surfaces of the tibias. The condyles of the femurs were flattened out. Because of the clinical history and the roentgen-ray findings the diagnosis of loose osteocartilaginous

FIG. 1. Case 26042. Front view of the left knee before operation.

bodies of both knees, probably due to osteochondritis dissecans, was made. (Fig. 1).

Operation for the removal of the bodies was performed October 13, 1920, by Dr. M. S. Henderson who noted the following: "The condition in both knees is very unusual. The normal convex surfaces of the condyles of the femur have been changed to concavities, and fringes of synovial menbrane with cartilage hang from both internal condyles. On pressure over these areas loose bodies can be felt. One piece of condyle about 3 cm. in diameter was removed on cutting through the cartilage in the right knee,

and two pieces each about 1 cm. in diameter were removed from the internal condyle of the left femur. The condition is probably a type of osteochondritis dissecans."

The patient's convalescence was uneventful and she was able to walk after two weeks. On the day of dismissal from the Clinic, thirty-two days after the operation, the motion at the knees was the same as on the day of admission, but no feeling of locking was experienced. (Fig. 2).

FIG. 2. Case 26042. Front view of the left knee after operation.

November 6, 1920, the tonsils were removed. The left tonsil contained fluid pus. Following tonsillectomy there was severe local and general reaction in the form of fever and chills and slight joint manifestation. The submaxillary glands were much inflamed. The knees were not involved in the reaction.

Etiology of Loose Bodies in the Knee Joint

Comparatively little has been written with regard to loose bodies in the joints. The underlying pathology is far from being recognized and the hypotheses advanced are only speculative. The

condition has not been produced experimentally in animals. No bacteriologic or serologic examinations are reported to prove or disprove its infectious origin. Judging from the changes observed in roentgenograms and at operation the production of loose bodies in joints seems to be gradual.

John Hunter explained the presence of loose bodies in the joints by the transformation of a blood clot in the joint into cartilage. He thought that effused blood, "from a species of sympathy," would be transformed into a tissue similar to that in which the blood was effused; it would assume the character of bone if effused between the ends of bone. This theory is interesting but not convincing. Kopp, and Henderson[2] have suggested the name "osteochondromatosis" for a condition of the synovia of the capsule characterized by thickening with formation of fringes which develop into loose bodies. These changes have been explained by others on the basis of inflammation, but Henderson believes that they are a form of benign new growth of the synovia. Not infrequently loose bodies are found in hypertrophic arthritis as a result of separation of the osteophytes following trauma to the joint. In many cases of neuropathic joints (Charcot joints) loose bodies may be produced but they never cause mechanical derangement. König, in 1887, described a rare condition known as osteochondritis dissecans in which the ends of bones become brittle and give rise to loose bodies. His hypothesis is that occlusion of one of the small end arteries supplying an area on the mesial surface of the internal condyle of the femur resulted in a separation of a small portion of the condyle. Henderson has observed that most of these changes take place at the insertion of the posterior crucial ligament on the external ridge of the internal condyle of the femur. He believes that the constant strain imposed on this ligament by the physiologic action of the knees produces changes in the tissues at its insertion which may have something to do with the formation of loose bodies.

Discussion of Case

Several points of interest are brought out in the study of this case. Focal infection must be considered in any arthritic condition. In this case there was definite infection in the tonsils. Although their removal was followed by a septic reaction, the knees

were not involved, suggesting that infection was not an etiologic factor. There were destructive changes in the articulating surfaces of the femurs and tibias which were disproportionate to the amount of disability. These extensive pathologic changes may be regarded as a result of the abnormal brittleness of bone due to some metabolic disturbance. In this case there was definite evidence of hypothyroidism. In a group of individuals who have a low metabolic rate there are joint symptoms such as pain and crepitus. If the disturbance in metabolism is due to a hypofunction of the thyroid patients may be relieved of their arthritic pains by the ingestion of thyroid extract. It seems that certain changes must take place in joints when the metabolic rate is low. These changes have not been investigated but there is enough clinical evidence to suggest their relation to a hypofunction of the thyroid gland.

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Editorial

REPORTING RESULTS IN FRACTURES.

There are likely to be fallacies in a statistical report of any kind. It is notorious that surgeons as well as financiers may, and sometimes do, employ figures to support conclusions, which might in the hands of another enable one to arrive at very different opinions.

The editor has observed this tendency quite largely in the reports of surgeons on the results of the treatment of fractures. This is true especially in reporting upon results in the open treatment of fractures. It is not sufficient to arrive at conclusions regarding the open treatment of fractures simply to say that patients recovered, had infection, failure of union, delayed union or refracture, in certain percentage of cases. What one really wants to know is the length of disability and the ultimate effect upon the patient. One must know his exact condition after operation as compared with his condition before.

In the treatment of fracture of the femur for example, simple or compound, ones impression is that open treatment, especially if followed by complications of any kind, very greatly prolongs the period of disability and very greatly endangers the patient's ultimate functional restoration.

If Lane plates are used, final functional recovery is often postponed for months while the question of retention of the plate or removal is under consideration. If infection occurs either at the primary or the secondary operation the return of the patient to duty may be postponed for a considerable length of time. If osteomyelitis develops upon either occasion, and especially if the plating has been done for a simple fracture, the patient is seriously damaged and the surgeon has a heavy responsibility to carry.

If we are to arrive at satisfactory conclusions as to the relative value of methods in the treatment of fractures, it seems to the Editor necessary that the following or similar questions must be answered with regard to every case:

First: Date of fracture.

Second: Character of treatment during the first ten days.

Third: Description of operation, if any.

Fourth: Temperature course before and after operation.

Fifth: Exact kind, and method of application, of splint.

Sixth: Length of time in bed.

Seventh: Length of time in hospital.

Eighth: Exact condition upon being discharged from hospital. (Position of fragments, length of limb range of motion in adjacent joints, etc.)

Ninth: Kind of treatment after being discharged from hospital.

Tenth: Date of discharge from all treatment. (Also same information as under eight.)

Eleventh: Occupation and duty before injury.

Twelfth: Date of return to same duty.

Thirteenth: If not able to return to original occupation, kind of employment after discharge.

Fourteenth: Vocational re-training methods employed, if any. (One might almost add also exact earning capacity before and after injury and treatment.)

If the above questions are fairly answered for each patient in all fracture reports, we shall be able to decide whether or not the surgeon is returning his patients promptly to duty. We shall also be able in time to conclude, as to the profession at large, which methods are securing functional results in the shortest time. There are very few fracture reports being made to the medical journals that give us reliable information on most of the above points. Conversely the fracture reports that we are having in the journals are such as either actually to mislead us or that give us information of little value in concluding which methods are most useful. In fact most of the reports simply tell us whether or not the patients survive to be discharged from the hospital and from professional care.

EDITORIAL NOTE

In a discussion of fractures in the November issue reference was made to an article by Dr. Ethan H. Smith in the New York Medical Journal for the preceding month. By error this article was credited to the Medical Record.

Book Review

A Consulting Surgeon in the Near East. By A. H. Tubby, C. B., C. M. G., M. S., Consulting Surgeon to the Westminster Hospital. Cloth. Price, 15 shillings net. Pp. 279 with illustrations. London: Christophers, 1920.

Mr. Tubby has written previously an excellent two volume text book on Orthopaedic Surgery. This book is quite different. It is a rather personal narrative of the authors experiences on duty as a consulting officer at Gallipoli, in Egypt and in Palestine. Mr. Tubby tells us that he had the good fortune to have his family and a home in Cairo and in Alexandria for some time during the war. However, the author performed front line duty and duty as a Sanitary officer as well as exercising fully his functions as a consulting surgeon and as the organizer of an extensive surgical service. The book is sure to stand as one of the many that must be written before half will be told of the contributions of medicine and surgery to the war.

The sixth edition of Dr. Whitman's excellent "Treatise on Orthopaedic Surgery is reviewed by Dr. Robert B. Osgood in the January "Annals of Surgery." It is stated that Dr. Whitman's book is "perhaps the best American text book on the subject" and practitioners of Orthopaedic Surgery as well as students are urged to read it "carefully and often."

News Notes

TREND OF WORKMEN'S COMPENSATION

An article contributed by Will J. French, in the November issue of the Monthly Labor Review, summarizes compensation history, past and present. The most important recent legislative development of workmen's compensation legislation is in extending the benefits of compensation acts to include vocational re-education and rehabilitation of men disabled in industry. Without waiting for the Federal Industrial Rehabilitation Act, a numbei of states have proceeded independently to provide re-education for injured workers.—*Modern Medicine.*

A reconstruction hospital has been organized for New York City at 5 Livingston Place. Dr. Joseph A. Blake is Chief of Staff. The object of the hospital will be to apply war lessons in surgery to the relief of civilian injured and crippled. There will be departments of vocational training and guidance as well as the usual hospital departments.

The following letter from Dr. Ridlon to the Journal is of interest to all our readers:—The Liverpool Courier of February 1, 1921 gives an account of the dinner "last evening" at the Adelphi Hotel in honor of Major General Sir Robert Jones, K. B. E., C. B., at which the Earl of Derby presided. The occasion was the retirement of Sir Robert from the Royal Southern Hospital, on the staff of which he has served for thirty years.

A "glowing eulogy" was spoken by Lord Derby, head of the War office. A portrait of Sir Robert by Mr. Morrison was presented to him by "the committee, surgeons, physicians ,and doctors of the hospital, together with the Bishop of Liverpool."

At about the third toast some one was heard to say: "Sir Robert be blowed! Bob Jones, here's your health."

Sir Robert Jones was the guest of honor at the annual dinner of the Medical School of the University of Bristol, and delivered the principal address. Sir Robert also gave the Cameron lecture at the University of Edinburgh on January 14th. The Cameron prize —awarded to him on this occasion because he had, "in the course of five years immediately preceding, made a highly important and valuable addition to practical therapeutics" was returned to be used as a prize for Orthopaedics in the University of Edinburgh.

The New York Post-Graduate Medical School and Hospital announces that there will be available this year six scholarships under the terms of the Oliver-Rea Endowment.

The purpose of the Endowment is to award scholarships to practicing physicians of the United States to defray in full the expenses of tuition at the New York Post-Graduate Medical School.

According to the wishes of the donor, physicians in the State of Pennsylvania will receive preference in the award of these scholarships.

Applications may be sent to the President of the New York Post-Graduate Medical School and Hospital, 20th Street and Second Avenue, New York City.

Dr. J. D. Griffith of Kansas City has recently completed the organization of a Clinic or Group of forty-two physicians. The Clinic will have its headquarters at St. Joseph's Hospital.

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Current Orthopaedic Literature

SWYNGHEDAUW—CASE OF SCOLIOSIS, TREATED BY EXTENSIVE RESECTION OF THE RIBS. *Societe de Medecine du Nord*, July 9, 1920, in *Echo Medical du Nord*, October 9, 1920.

The author presents in the name of Professor Gaudier and his own a girl with scoliosis of the second degree with very marked costal deformity, treated by extensive resection of the ribs. This method is the first attempt of the surgical treatment of scoliosis and seems destined to give very interesting results, all though it is not directed against the deviation of the spine itself, it remedies the thoracic deformity which is much more apparent and more disfiguring.

This is the second attempt made by Professor Gaudier: the first case was operated before the war in which immediate results were very good were lost sight of. This is only the beginning of the treatment. It is also necessary subsequently to model the thorax by the aid of plaster of Paris cast. Dr. Gaudier adds to this communication that the surgical treatment of scoliosis is a very delicate question. At the last congress this method has met with violent protexts on the part of Orthopedists. These cases prove, that you can obtain a mobilization of the thorax with the aid of the rib resection. Gaudier is convinced that within six months he is able to obtain an exceedingly good result. This procedure is applicable even in advanced cases of scoliosis. (This report entirely ignores the work done by Michael Hoke of Atlanta, Ga., along the same line and with the same method, about ten years ago.)—*A. Steindler, Iowa City, Ia.*

ANASTOMOSES TENDINEUSES POUR LESIONS TRAUMATIQUES DES NERFS. Mauclaire. IIe Congres de la Societe Francaise d'Orthopedie, 8 octobre 1920. *In Presse Medicale*, no 77, 23 octobre 1920.

Indications generales.—L'operation sera primitive si la lesion des nerfs est jugee d'emblee tres etendue, incurable.

Elles sera secondaire quand, au bout d'un temps assez long, un an en moyenne pour le nerf radial, deux ans pour le nerf sciatique, il n'y a aucun signe de regeneration. Vouloir attendre plus longtemps, c'est attendre un allongement tres marque des tendons qui perdent leur elasticite, sans compter la gravite des lesions osteo-articulaires concomitantes.

L'operation est indiquee non seulement pour les pertes de substances des troncs nerveux, mais aussi pour les paralysies partielles des nerfs resultants d'une section totale d'une ou plusieurs branches; de meme pour les sections partielles du tronc nerveux et pour les compressions partielles par du tissu sclereux, provoquant les paralysies curleuses, dites dissociees, expliquees par la topographie fasciculaire dans le tronc du nerf.

Technique.—Le nerf radial est celui qui a le plus exerce le sagacite des chirurgiens pour les anastomoses tendineuses; Mauclaire, avec son eleve Massart,s'est arrete a la technique suivante: detachment le plus bas possible des muscles cubital anterieur, grand et petit palmaire, en empietant sur l'aponevrose palmaire pour gagner de la longueur; plissement des tendons extenseurs sur 1 cm. 1 2; passage sous-cutane des tendons anterieurs et suture du tendon du cubital anterieur aux deux tendons internes des tendons extenseurs; suture des grand et petit palmaires aux tendons externes des extenseurs. Enfin suture des deux paquets tendineux externe et interne ainsi formes.

Si les tendons anterieurs sont tres raccourcis, on les fait passer par l'espace interosseux.

Les *resultats* sont bons, a condition que l'operation ne soit pas trop tardive.

Des anastomoses tendineuses ont encore ete faites pour des paralysies du median, du cubital et du musculo-cutane.

Au *membre inferieur*, c'est la solidite qu'il faut rechercher; les anastomoses tendineuses ont peu d'indications.

Dans la paralysie traumatique du nerf crural, l' arthrodese du genou est preferable; dans celle du tronc du sciatique, l'arthrodese tibio-tarsienne.

"Les anastomoses tendineuses sont a conseiller surtout pour les lesions definitives des nerfs du membre superieur et principalement du radial; elles ont donne des resultats tres encourageants. A notre avis, dans la derniere guerre, elles n'ont pas ete assez souvent pratiquees chez les blesses atteints de lesions nerveuses definitives: il est vrai que beaucoup ne s'y pretaient pas volontiers."—*Archives Medicales Belges.*

CERVICAL DEFECTS

A recent number of the Italian journal which is devoted to the surgery of the locomotive organs was entirely given up to an article of 104 pages on congenital anomalies of the cervical vertebrae by Dr. Mario Bertolotti, who is in charge of the radiological departments of the University of Turin and of the Ospedale. Maggiore. This monograph is based upon 18 cases, of all but one of which radiographs are included. Most of the patients were brachicephalic, and in a number torticollis was present. One of them presented the usual features of a congenital muscular torticollis, such as shortening and sclerosis of the sterno-cleido-mastoid muscle and facial asymmetry, but a radiograph revealed the interesting fact that there was ossification of some of the deep muscles of the neck on the same side as the contracture. One case of cervical defect had also a typical spina bifida occulta in the loin. Several cases are described as "pseudo-Potts," the diagnosis of which might have been difficult but for the X-Rays, especially when scoliosis also was observed. The radiographs are very good and clear. The author has found that the best radiographic results are got by placing the patient prone, with the head in forced rotation to one side, and the source of the rays in a position corresponding to the tip of the fifth cervical vertebra. Two views are taken, one in a right anterior oblique, and the other in a left anterior oblique plane. The bibliographical supplement to this periodical is a useful publication.—*British Medical Journal.*

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The Journal *of* Orthopaedic Surgery

THE NON-OPERATIVE TREATMENT OF SCOLIOSIS

BY WALTER TRUSLOW, M. D. BROOKLYN, N. Y.

In approaching what is perhaps the most difficult problem in Orthopedic practice, one would wish to be clear in defining the subject. This paper will deal with true rotary lateral curvature of the spine—that is, with the well-known deformity, with structural changes. Functional scoliosis must be dealt with carefully and thoroughly, but is not the bete noir that structural scoliosis is.

It is necessary also to understand just what one may expect to accomplish, and not to pre-suppose what at present seems impossible. Successful treatment of rotary lateral curvature of the spine contemplates (1) stopping the deforming process, (2) materially lessening existing deformity, and (3) reasonably assuring the non-return of the deformity. The present writer agrees with the findings of the recent Scoliosis Committee of the American Orthopedic Association, which stated that no known method had yet been found to restore to body symmetry a structural scoliosis; but he believes that the ends just outlined are worth striving for and are attainable.

Every case must be considered individually; but, in general, the non-operative treatment of structural scoliosis consists in a careful weighing of the indications for and the proper use of (1) corrective plaster-of-Paris jackets, with pressure paddings and negative window spacing, and (2) of specific intensive exercises, with retention brace or corset—often an alternating use of these means. We usually state our procedure in treating deformities, thus: "Correct the deformity first, then insure its non-recurrence." Practically, in the deformity under discussion, we find no means completely to correct the deformity, and I think that most of us agree that there is a very definite limit to the forces

which we can exert on the individual patient. So it has long appeared to the writer that the one who assumes professional charge of these patients should outline a procedure which should allow the use of both means, and that he should demand for himself reasonable freedom of decision as to when either should be used. Practically, in the writer's hands an alternation of the plaster corrective jackets and of the retention-muscle training has often been most effective.

But it is insisted that the judgment of the one in charge must be formed and controlled, not only by his observation of the patient's varying general condition, but particularly by a system of measuring of the specific elements of deformity which should be reasonably accurate and yet so easily applied as to be used at each change of plaster-of-Paris jacket and at monthly intervals while the intensive exercises are being taken.

After first hunting for and eliminating, if possible, unequal lengths of legs and congenital bone asymmetries, the writer finds the following elements of deformity necessary to record at regular intervals:

1. Deviation of the spine, standing.
2. Relative carriage of shoulders, standing.
3. Relation of lateral upper trunk lean to a spinal perpendicular, standing.
4. Deviation of spine, in prone lying.
5. Rotation of spine, in prone lying.

They can be recorded in from five to ten minutes, and the succeeding records, rightly studied, are exceedingly valuable. The patient stands with back exposed from neck to buttocks' fold. A strip of adhesive plaster is placed over the spinous processes, from seventh cervical to first sacral (at top of buttocks' fold); the successive spinous processes are palpated and marked on the adhesive plaster; the level of right and left scapular angles are projected and marked on the margins of the adhesive plaster. A plumb line, representing the "sacral perpendicular," is then hung in such a manner that its weight will be opposite the buttocks' fold and the upper end to right or left of the seventh cervical marking. Where the string is opposite the seventh cervical point, a mark is made on the adhesive plaster. To make a permanent record of this, the adhesive plaster is transferred from the pa-

tient's back to any flat surface, and the following lines drawn and distances measured. A line is drawn, with ruler guide, from seventh cervical to first-sacral dot. It is called "spinal height." A line is drawn from it to the dot, representing greatest dorsal deviation; another to greatest lumbar deviation. Either marking, for scapular angle, is projected across the adhesive strip, to get its level relative to that of the opposite scapular angle. Measurements are taken as follows:

a. of dorsal deviation.

b. of lumbar deviation.

c. of spinal height.

d. of relative scapular levels.

e. of projection, to right or left, of seventh cervical vertebra to sacral perpendicular.

A history sheet record of the above reads, for example:

Spine, standing;

Spinal deviation $\dfrac{3.2 + 1.5 -}{45} = .1044$ or $10\frac{1}{2}\%$

Carries left shoulder 3.3 lower.

Carries 7th cervical 1.6 to the right.

The above is a record of certain elements of deformity in standing or weight-bearing posture.

To obtain a record of bony changes, weight-bearing must be eliminated. The patient is placed in a standard position prone upon a table. Another strip of adhesive plaster is used upon the exposed back from seventh cervical to buttocks' fold. Successive spinous processes, from seventh cervical to first sacral, are palpated and marked. Rotations in degree are obtained by the use of the writer's rotatometer. This consists of two hinged arms, with a recording sector fixed to one, and an indicator fixed to the other. The arm with the fixed sector is placed across the back, at the position of greatest dorsal rotation. It takes such tilt to the horizontal as this back transverse may give it. The arm with the index has also a spirit level. This arm is moved up and down until it is levelled, and the degrees of rotation are read as at the place which its index takes on the sector of the other arm. The greatest lumbar rotation (sector arm tilted in

the opposite direction) is taken in the same way. The adhesive strip is transferred, and is ruled and measured for spinal height and for dorsal and lumbar deviations, as when taking these measurements with the patient in the standing position. The history sheet record of these measurements would read, for example:

Spine, prone;

Spinal deviation $\dfrac{2.2 + 1.1 -}{45} = .0733$ (or $7\frac{1}{3}\%$)

Rotations, 8 degrees and 5 degrees.

Comparison of the relative measurements of the standing and of the prone positions, of the amount of self-correction possible and of the examiner's correction is an aid to prognosis, but is particularly important in determining how effective is the treatment, and what feature of deformity correction must be emphasized in continuing treatment.

Details of the plaster-of-Paris corrective jacket will not be dealt with at this time. Effective methods of procedure are well known. Each surgeon must use that which he knows best. But some features of technique seem worth emphasizing. First, one must have a very clear idea of the elements of deformity to be corrected. The writer finds it more effective to depend upon the application of the jacket to correct the faulty upper trunk-lean and the low shoulder, and upon the exact placing of subsequent paddings to correct the spinal deviations and the rotations; rather than to emphasize the correction of all deformity elements by the position of the patient upon which the jacket is built. To this end the hips-flexed prone lying position upon the hammock in the frame is chosen. Before plaster dressings are applied, the pelvis is fixed and then the upper trunk is stretched longitudinally and in such a manner laterally as to carry faulty upper trunk-lean across to the opposite side and to lift the low shoulder. This, of course, lessens spinal deviation and, to a slight extent, rotation; but the emphasis is placed upon the faulty upper trunk-lean and the low shoulder. Having in consideration proper counter pressures, when paddings shall be used, care is taken that the transverse of the shoulders shall be in the same plane as the transverse of the pelvis. This and succeeding plaster jackets are distinctly corrective, but pressure forces are to be made quite within the limit of comfort.

Negative window spaces are cut out and first paddings to correct spinal deviation and rotation are applied in two weeks. Succeeding paddings are applied once a week to six weeks from the application of the plaster jacket. During that period the plaster rigidity itself prevents any further correction in the faulty upper trunk-lean and in the low shoulder; but much correction of the spinal deviations, of the rotation and of the anterior rib deformities may be obtained. The writer emphasizes this point, as he believes that hazy understanding of it accounts for indifferent success.

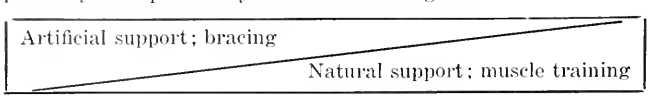
The appointment for the application of the second corrective jacket must allow sufficient time to take the measurements, to apply the plaster body mould (a rear half is sufficient), from which a cast is to be made for the retention brace or corset, and then to apply the second corrective jacket. The patient's position for the plaster mould for the brace cast is also hips-bend prone and with over-correction of the faulty upper trunk-lean and with levelled shoulders. The position for the second corrective jacket is hips-bend prone with marked over-correction of the faulty upper trunk-lean and with over-correction of the low shoulder. Its program of four to six weeks is similar to that of the first corrective jacket. It has been applied in greater length, to meet natural growth plus spinal lengthening due to lessening of spinal deviation and spinal rotation. During the wearing of it, further correction of deviation and of rotation and front chest moulding will have been accomplished.

At the end of three months, the figures representing spinal deviation should have been reduced about one-half and that representing spinal height should have been slightly increased. This should reduce the ratio of deviation deformity about one-half, or, for example, a ten per cent deviation deformity should be about five per cent. The upper trunk-lean, as indicated by the relation of seventh cervical vertebra to sacral perpendicular, should have been carried nearly to, or, perhaps, passing across the vertical line; and the shoulders should have been levelled. In this time it is usually possible to reduce the figures indicating rotations also about one-half. Although the correcting forces have been but gradually yet steadily applied, and although the cooler months of the year have been chosen and the "scratcher" faithfully used daily, the patient's skin and the patient's disposition will not tolerate more than three months of these jackets.

What is now to be done? We know that much of the deformity will recur if we do not hold what we have attained and so train the muscles by intensive exercises that they will increasingly be able to assume the task of natural support, with ever lessening artificial support. The brace or corset, planned for at the time of changing the plaster corrective jackets, should now be ready.

A truly retaining brace is difficult to attain, but is important. The requisites are (1) ability to hold correction attained; (2) "fool-proof"—the patient must be able to apply it with reasonable accuracy; (3) extensibility to meet normal growth, and longitudinal extensibility and lateral compressibility to follow further deformity improvement which proper exercises will surely give; and (4) finally, if possible, self-correction. (The writer believes that this last will be possible by the use of a laterally bending upper segment of the brace and a stop-joint to prevent bending in the directions of deformity increase. The mechanical difficulties, however, are such as to make a presentation at this time of what has been accomplished premature). The Knight spinal brace can be modified to meet all of the requisites outlined, except self-correction. The brace must be worn by night as well as by day at first.

With the removal of corrective jackets and with the assumption of the retention brace, the intensive exercises begin. The brace is removed for the exercises only. The patient's back is exposed for all exercises, to observe every detail of movement. The starting positions are in kneeling, on hands and knees, in prone lying, on the back, half prone at end of table and finally sitting, to insure as little erect weight-bearing as possible and because from these positions best concentration on the parts to be exercised is obtainable. The muscles must gradually be trained to assume the responsibility of weight-bearing. As the muscles get stronger and bring the superimposed body segments nearer and nearer to the line of gravity of the body, the artificial support of the brace is less and less used. A simple reinforced corset becomes possible. The relation of artificial support to natural support may be expressed by the schematic diagram:



The exercises are classified as Preliminary and Deformity Correcting. The purpose of the preliminary exercises is:

1. To train the patient to take the starting positions and the simplest variations accurately;

2. To "limber up" the stiffened muscles and ligaments of the trunk, the shoulder girdle and the hip-joints; and

3. To start the correction of the exaggerated antero-posterior spinal curves.

All of the *preliminary exercises* are symmetrical.

I. Kneeling.

1. With hands on hips; trunk bending forward.

2. Alternate foot placing forward.

II. On hands and knees.

1. Alternate head and mid-back raising.

2. Trunk swaying forward to prone lying, then backward to resting on heels.

3. Alternate thigh extensions backward to horizontal.

4. Alternate arm extensions forward.

III. Prone lying.

1. "Seal"—with hands clasped low behind the back; raise head and shoulders and arms.

IV. Lying on back.

1. With knees drawn up (feet resting on the floor); bend both knees to the chest.

2. With arm stretched upward beyond the head; arm flinging forward, raise trunk to sitting, to forward reach to toes.

V. Half prone lying at end of table.

1. Alternate thigh raising to horizontal (knee straight).

2. Raising both thighs to horizontal (knees straight).

3. With arms stretched out at sides; raise head and shoulders and arms.

VI. Sitting.

1. With feet apart and dumbbell on floor between; raise weight floor to right shoulder, to high, to shoulder, to floor, to left shoulder, to high, to shoulder, to floor.

About a week is sufficient time to give to the preliminary exercises.

The intensive corrective exercises are progressively based on the preliminary exercises. They are asymmetrical. They aim definitely to correct the specific features of the deformity—the upper side trunk-lean, the low shoulder, the compound spinal deviation, the exaggerated antero-posterior curves, and especially the rotations. It is believed that this is accomplished by actively and progressively using the muscles which must be depended upon to maintain these corrections. For clearness of wording, the type—right dorsal left lumbar—is here chosen. Modifications of the following exercises must be chosen in variations from this type.

Intensive *Corrective* (Rotation) *Exercises.*

1. Kneeling.

1. With cane in hands; bend trunk forward to the left, reaching left side of cane far forward to the left, carrying right arm (half bent) sideways upward, with upper trunk twist to the right.

II. On hands and knees.

1. Stretch right thigh backward and left arm forward (synchronous movement).

2. Place left foot forward on the floor and raise right arm sideways upward with upper trunk twist to the right (synchronous movement). (Later).

3. Stretch right thigh far backward, sway trunk backward (to sitting on left heel), raise right arm sideways upward, twisting upper trunk to the right (synchronous movement).

III. Prone lying.

1. With left arm forward (to the left) on the floor, head resting on left arm, and with right arm out sideways on the floor; raise right arm sideways upward with upper trunk-twist to the right.

(Later, with increasing dumbbell weight in right hand).

IV. Lying on back.

1. With knees drawn up (feet resting on the floor); keeping knees parallel, bend toward the chest, twisting so that knees point to the right (feet to the left).

2. With arms over head on the floor; raise trunk to sitting, to left hand touch to left toe and with right arm raising sideways upward and upper trunk twist to the right (synchronous movement).

V. Half prone lying at end of table (feet on floor).

1. With upper trunk placed to the left on the table, left arm reaching far forward to grasp left side of table and right arm stretched out sideways; raise right thigh to horizontal (knee straight) and raise right arm sideways upward (synchronous movement).

(Later, add increasing dumbbell weight in right hand.)

2. (Later) Repeat V. 1, but raising both thighs to horizontal (gradually getting an increasing twist to the low spine, by elevating the left hip and thigh).

VI. Left thigh support sitting on bench—"spring sitting."

1. The left thigh is supported on the bench, the right thigh-leg-foot is stretched far backward, a dumbbell is held at each shoulder; bend trunk forward to the left, reaching left arm forward (over left knee) to the floor, raise right arm sideways upward, with upper trunk twist to the right (synchronous movement).

2. Left hand-support "spring sitting"—The left hand rests on a table far forward, the remainder of the body in spring sitting; raise right arm sideways upward with upper trunk twist to the right.

The above exercises are planned with the least apparatus possible, so that the patient may do them at home daily. Where the operator wishes to keep entire control of all of the exercises in his own gymnasium, much elaboration will suggest itself and such apparatus as the Swedish plinth, stall bars and bom, will add to the effectiveness of much of this. The writer outlines an exercise program as follows: (1) For first month, at office gymnasium once a week, (2) for second month, two office visits, (3) thereafter, once a month at office gymnasium. This is supplemented with a written gymnasium prescription (GR/p.) of daily home exercises, which is added to usually at each visit.

Experience has shown that these exercises are truly corrective and especially of the rotation deformity.

Now, to estimate the relative merits of the three procedures and the amount of time to be given to each:

1. The corrective plaster jacket lessens deformity more rapidly than does brace-wearing or exercises. It affects rotation least of all of the elements of deformity. It has distinct time limitation because of skin-pressure intolerance and because of the patient's attitude toward it. It must be re-assumed after a shorter interval of bracing and exercises in the paralytic spine patient.

2. The retentive brace alone will delay deformity formation. It will bring about no correction of it, and unless constantly cared for, will allow increase in deformity. It is inadequate in the paralytic spine.

3. Exercises alone will not be sufficient to prevent an increase in a deformity in which the ratio of deviation is greater than four per cent. It must be used with very gradual progression in the paralytic. When reinforced by an efficient retention brace and intermitted with an occasional short return to the corrective jacket, it is the best means available for insuring a stopping of deformity progress, for insuring a large amount of deformity lessening, and, by its general hygienic, as well as local effect, for a reasonable assurance of non-return of deformity.

As to time necessary, one would say that a structural scoliosis presenting five per cent deviation or less would require about one year of active treatment—plaster corrective jackets for three months, nine months of retentive brace and intensive supervised exercises; and that in the second year a girl could wear a simpler reinforced corset and do her home exercises daily, with occasional supervision of the doctor. A ratio of deviation of five to ten per cent would require three months of corrective jackets; six months of retentive brace and intensive exercises; three months of corrective jackets, and a second year of bracing and supervised exercises. Greater amounts of deformity would require longer time. The paralytic, if treated non-operatively, must have a larger proportion of the time given to the corrective jacket and must be carried on for several years.

Summary:

1. Successful treatment of structural scoliosis must depend upon a clear understanding of the elements of deformity, and the lessening, if not complete elimination, of all of them.

2. Uniform and regular measurement and numerical record of the elements of deformity are important as guides to continuance of treatment and as indicating elements most needing correcion.

3. A balanced use of corrective plaster-of-Paris jackets, of retention brace and of intensive exercises is essential to satisfactory results.

4. The position of the patient when the plaster jacket is applied is responsible for improving body posture and shoulder carriage; the successive paddings, for care of the spinal deviation and the rotation.

5. Essentials of a retention brace are (a) ability to hold correction attained; (b) application by the patient with reasonable accuracy; (c) extensibility and lateral compressibility to meet normal growth and progressive deformity decrease; (d) mechanical self-correction by the brace seems possible, but not yet fully attained.

6. Gymnastic exercises must be progressive, intensive and with a minimum of erect weight-bearing. They must aim to correct all of the elements of deformity, especially that of rotation. Starting positions other than standing facilitate these ends.

7. Retention of deformity correction attained must be maintained while exercise is developing natural muscular support. Artificial support may gradually give way to natural support. The paralytic scoliotic must receive a larger proportion of artificial support than will be required for those not paralyzed in the trunk muscles. Internal splinting, by operative bone-fixation, may also be necessary in severe paralytic cases.

CHRONIC CIRCUMSCRIBED OSTEOMYELITIS

BY DR. WALTER G. STERN, M. D., F. A. C. S., CLEVELAND, OHIO.

Influenced by a more attenuated form of infection, an unusually small bacterial embolus or by an unwonted resistance of the bones involved, a noticeable percentage of cases of osteomyelitis run a chronic and circumscribed course. The first period of invasion is quite as stormy as in any case of osteomyelitis, but the patients are not quite so septic as is ordinarily noted and instead of the process developing into a wide-spread necrosis with sequestrum formation, etc. in the usual manner when unoperated, the temperature goes down, the pain lessens and the oedema of the soft parts tends to disappear; the pain and disability and the bone and periosteal thickening alone remain more or less permanent. Apparent healing may even take place, lasting for years. (Case 1). In some cases there may occur periodic recrudescences with pain and fever (Case 2) and in other cases severe neuralgic pains persist for months and even years (Case 3).

The condition tends to become multiple and symmetrical, involving the other bones simultaneously or in succession (Case 4).

The most striking clinical feature of this form of osteomyelitis is the relatively enormous tumefaction and induration of the bone and periosteum, which forms around abscesses or necrotic areas which are usually situated in the metaphysis or in the ends of the diaphysis of the long bones. The abscesses can be multiple and each one is a center for symmetrical thickening. The abscesses may contain pus or seropurulent fluid.

The induration may be so circumscribed and develop so steadily, that suspicion of bone sarcoma may be aroused as in Case 5. In this case more careful examination revealed multiple lesions, while the radiographs showed areas of circumscribed necrosis within the center of the thickened bone.

In 1850 Sir Benjamin Brodie described a chronic abscess situated in the upper part of the tibia, characterized by a thickening of this portion of the tibia. Where the abscess formation has been the most prominent feature, these lesions are often called Brodie's abscesses. Keen holds that Brodie's abscesses are identical with the abscesses of chronic circumscribed osteomyelitis oc-

curring in the vicinity of the epiphyseal line of the long bones, especially the tibia, femur and humerus. It has been held by many observers that the typical Brodie's abscess is a form of tuberculosis of the shaft of the long bones and there are animal experiments to prove that given cases were indeed tuberculous. Whether Brodie meant to describe a tuberculous or a non-tuberculous process is not accurately known, but in the series of cases of chronic circumscribed osteomyelitis reported by Klemm and other writers and in the cases observed by the author, there can be no question of tuberculosis raised. All these cases were distinctly pyogenic blood infections and in all the usual pyogenic organisms were demonstrated. In all our own cases the tuberculin reactions were negative, and guinea pig injections, when made, were also negative for tuberculosis.

The radiographic appearances of these lesions are quite characteristic. There are one or more sharply marked, ovoid areas of bone necrosis, usually in the ends of the diaphysis of a long bone, especially of the tibia, surrounded by a greater or lesser amount of tumefaction. It is unlike the usual picture of irregular sequestrum and involucrum formation characteristic of the usual type of osteomyelitis. It is more sharply localized and produces less bone destruction and more bone over-production. The picture of the lesion is sharp and clear, never blurred, hazy, indistinct or "smokey."

Upon operation, the bony walls of the necrotic areas are often found eburnated and the cavities filled with pus, granular bony detritus, bone spicules, granulation tissue or even thick necrotic masses resembling brain substance. The walls are often lined with a dense, smooth, tough membrane which is difficult to scrape away. Sequestra, other than small bone spicules, are rare. No cysts or limiting cyst membranes will be found on pathological examination.

Chiselling away the walls, followed by a thorough curettage of the cavities with the removal of the dense lining membranes, followed by Mosetig bone wax or the Carrel-Dakin technic, is usually all that will be required to bring about a cure. When possible the usual fresh air and heliotherapy regime given to any case of chronic local infection should be used.

The diagnosis is at times exceedingly difficult and Kocher and his pathologist are on record as having mistaken cases for sar-

coma and made the diagnosis only by the clinical course of the disease. Klemm speaks of a case where the operative findings and the pathological pictures were identical with sarcoma, but the ultimate course showed it was a case of osteomyelitis.

The disease must be differentiated from tuberculosis, syphilis, sarcoma, chondroma, bone cyst, osteomyelitis hemorrhagica and Paget's Disease. The differentiation is exceedingly difficult and must be made from the clinical course of the disease, laboratory tests and X-Ray findings, altho the latter are rarely characteristic enough to be the sole determining factor. A leucocytosis is present only during active febrile stage.

The prognosis is, of course, much more favorable than in the usual type of osteomyelitis.

ILLUSTRATIVE CASES

Case 1. Boy age 16. At the age of 6 years received a fracture of the humerus; a few weeks later, ushered in with chills and fever, an infectious osteomyelitis of the upper part of the tibia developed and was the cause of an extensive bone operation, the details of which cannot be learned at this time. The wound was packed and remained open for a time, but finally healed before the age of 7 years. At this time a swelling of the internal malleolus was noticed but as it did not pain him it was not operated upon.

For the past 9 years the enlargement of the malleolus has persisted, until it has forced the foot into eversion. Patient comes for the relief of his "flat foot." Has pain only when he injures bone, never has had redness, swelling, fever or spontaneous pain.

The radiograph shows only thickened and eburnated bone. The lower end of the tibia is at least half again as thick as normal.

Operation revealed an adherent and smooth periosteum with dense bone beneath; no signs of periostitis. After chiselling thru at least one inch of dense bone, a cavity was opened up which was filled with granular tissue, inspissated pus and bone debris. Cavity walls smooth and covered with fibrous membrane, this was removed and cavity packed with Mosetic Bone Plug. Cultures showed a pure culture of Staph. Pyogenes Aureus.

Case 2. Boy age 12 has been suffering for the past three years from periodic attacks of pain, gnawing in character, in the upper part of the right tibia. The attacks have been accompanied with fever, at times chills and intense swelling of the soft parts which, however, soon subsided after the pain ameliorated. He averaged four to five attacks of this kind per year. The radiographic findings are said to have been negative except for a thickening of the bone, and a diagnosis of Milroy's Disease was made. When first seen by me the history of repeated attacks seemed to be the only puzzling feature in the case. Otherwise it looked like a mild attack of osteomyelitis. The radiographs taken at this time showed a small area of necrosis the size of an almond in the center of the upper part of the diaphasis of the right tibia, surrounded on all sides by thick eburnated bone. Upon operation the cavity was found to contain creamy pus with a pure culture of staphylococcus aureus. Guinea pig injections were negative for tuberculosis. The tuberculin reactions were also negative. Leucocytosis 9000. The operative wound healed in a few weeks and for four or five months thereafter the boy enjoyed perfect health with the disappearance of all symptoms. Then the symptoms suddenly made their re-appearance but this time the pain, swelling and bone thickening occurred on the opposite shin. Leucocytosis 19000. The X Ray revealed a similar abscess on the left tibia and a similar condition was shown at operation. This abscess too, made an uneventful operative recovery.

Case 3. Woman age 30. States that as long as she can remember she has had excruciating neuralgic pains in the right shin, radiating down into the ankle joint. The crest of the tibia has always been roughened and the limb has always been thicker than the opposite side. Never remembers to have had any illness with severe pain, high fever and chill. Except for a moderate degree of enlargement of the entire shaft of the right tibia, more marked in the lower third, and some roughness on the crest of this bone, the examination was absolutely negative. The X Rays showed eburnation and enlargement of the tibia; no necrotic areas were visible. The Wasserman and tuberculin tests were also negative, and the patient had nowhere else any evidence of Luetic or tuberculous infection. No leucocytosis. Upon operation it was found that the center of the tibia at the junction of the middle and lower thirds contained an abscess filled with extremely

thick, brain-like material, containing some bone sand and lined with thick fibrous wall. The cortex of the bone, which was at least an inch thick was chiselled away, the cavity membranes scraped out and the soft parts tucked into the cavity according to the methods described by Carl Beck of Chicago. The patient made an uneventful recovery.

Case 4. Girl age 10. Otherwise in good health was suddenly taken ill with chills and high fever and pain in the lower end of the right tibia. This part of the leg became red, swollen, oedematous and for two days the child was extremely ill. The symptoms, however, soon subsided leaving a thickened, indurated area on the lower part of the right shin. Patient unable to walk on account of pain in the ankle joint. After a few weeks, ushered in by chills and fever, the same process took place in the lower end of the opposite tibia. The symptoms again lasted only for two or three days. When the case was brought to my attention the child was pale, aenemic, evidently suffering from a chronic sepsis, unable to walk on account of pain in both ankle joints, and the lower thirds of both tibias were enlarged, swollen and painful. No leucocytosis. X Ray photographs showed three distinct areas of breaking down in the lower part of the right tibia and two circumscribed areas of similar nature in the left tibia; the entire diseased area was very much thickened and the bone was already denser than normal. On account of the multiple necrotic foci and the symmetry of the condition a tentative diagnosis of Leutic osteomyelitis was made. The patient, however, presented no other signs of active syphilis and the Wassermann test was repeatedly negative. The tuberculin tests were also negative. At the time of operation, after chiselling thru the eburnated cortex, three cavities in the right tibia and two cavities in the left tibia were found. These cavities were not connected with each other and were filled with seropurulent fluid; the cavities were smooth, the walls lined with a thick, glistening membrane. The entire diseased area was chiselled out and the wound, bone wound filled with Mosetig bone wax, the periosteum and skin were tightly sewn over the wax plug, and the child made an uneventful recovery. Bacteriological examination of the seropurulent fluid revealed a pus culture of a diplococcus, the exact nature of which has not yet been determined by the pathological laboratory. His-

tological examination of the cavities shows that they were of inflammatory nature and not cysts.

Case 5. Mary, girl age 6. Brought to the Dispensary at Mount Sinai Hospital on account of a rapidly growing tumor in the metacarpal bone of the index finger of the right hand. Is said never to have been ill, never to have had, within recent times, chills and fever, and the swelling of the hand is rather painless. The skin over the growth was seamed with enlarged veins and a tentative diagnosis of sarcoma was made. On admission to the hospital a much smaller tumor of the metacarpal of the index finger of the left hand and a fluctuating mass in the right calf were also found. The radiographs showed in both the metacarpals, an immense amount of thickening confined to the distal half of the bone so that this part was almost twice as large as the proximal half. In almost the exact center of the enlargement was a fair sized area of destruction, sharp in outline and in no way resembling the destruction from sarcoma or tuberculosis. The radiograph of the right tibia and fibula were negative.

Upon operation the above mentioned cavities in the metacarpals were found to contain thick yellowish pus from which a pure culture of staphylococcus aureus was grown.

The mass in the calf was an abscess outside of the periosteum and beneath the muscles. It also contained the same staphylococcus. Nowhere could any thickening of the periosteum or roughening of the posterior surface of the tibia be discovered. The bone cavities and abscess were treated according to the Carrel-Dakin technic, but the recovery has been slow and heliotherapy has been resorted to with apparent success. The tuberculin and Wassermann tests have repeatedly been negative.

OSTEOMYELITIS FOLLOWING WAR INJURIES

Based on the Study of 61 Cases.

BY RICHMOND STEPHENS, M. D. NEW YORK CITY

It is practically impossible to determine the number of bone injuries from the recent war which have gone on to a very chronic condition and are still not cured. We do know, however, that there is a large number and that many of them will require long and careful treatment.

The men who have been discharged from Government Service now receive treatment from the Government through the War Risk Insurance Bureau and this work is carried on by the Public Health Service. A few men probably receive treatment from other sources but by far the large majority take advantage of this opportunity for care. As we know, several hospitals have been established throughout the country by the Public Health Service. I have been fortunate enough to be connected with such an institution in New York City and it is upon the work done there that this paper is based.

The Orthopedic Service is called upon to examine, advise and treat all cases which come under its scope. However, some cases go to the General Surgical, Neurological, Physio-therapeutic or Out-Patient Departments and we have not been able to observe them, but we do see all those that require Bone operations, Plaster-of-Paris or Brace treatment. During the first five months of the service we treated 174 patients for the War Risk Insurance Bureau. Of this number 61 or approximately 35% of the cases were suffering from Osteomyelitis in its most chronic form.

These introductory remarks are made merely to give an idea of the frequency of osteomyelitis resulting from war wounds. The figures are accurate but of course we cannot make many definite deductions for we do not know what proportion of the resulting war disabilities come to our attention. I believe that we can realize that there are many men with this condition and more than one would think after knowing all of the work that has been done and the good results reported by so many men by various methods of treatment.

We must take it for granted that all of these cases of very chronic osteomyelitis were at least closed at the time the men were examined for discharge from War Service. Probably most of them were pronounced cured and many similar cases may have been cured but we know that in this series they were only temporarily arrested or closed.

From these and other experiences we must conclude that one can practically never pronounce a case cured. Some apparently are but others may merely be quiescent for a short time or for a very long period. We all know that some cases of osteomyelitis have run extremely long courses. I have had a case called to my attention that was healed and supposedly cured for ten years and then developed a sequestrum which had to be removed. It is not uncommon to see cases that have been active for a long period and I recently saw one that still had a sinus which had been discharging almost continuously for over 20 years.

In this series of cases 7 were from causes other than gunshot wounds. The remaining 54 were the result of wounds from bullets, shrapnel balls or explosive shells, and necessarily were inflicted from 10 to 21 months before these observations and the osteomyelitis was quiescent for a variable period up to one year.

It is fair to presume that these cases received average treatment before this time as they were practically all in different organizations, wounded in different periods of the war and treated at many different hospitals, both in France and in the United States after their return. It has been impossible to determine what type of treatment was instituted in each particular case but we do know that many had several forms at different times and that others had one of the various types throughout the entire period of the active lesion.

From the above facts, it seems right to proceed on the assumption that the series is really a very fair average as regards early treatment, period of disability, etc. As to the type and severity of the original injury and as to the bone or bones involved, the following table will show us that in these respects also, the series is a good one for study.

Number of War Cases Examined		174
Chronic Osteomyelitis		61
Percentage of Osteomyelitis		35%
Osteomyelitis from Bullet or Shell Wound		54
Time Since Injury—10 to 21 months		
Longest time closed—Less than	6 mo.	49
	6 mo.	4
	7 mo.	1
	8 mo.	2
	9 mo.	1
	10 mo.	1
	11 mo.	1
	12 mo.	1
		61
Number of operations on each patient		1 to 8
Cavity present		14
Tunnel present (thru and thru)		5
Bone Fistula only		26
Superficial scar unhealed		6
Periosteoma		2
Trough (after operation)		4
Osteomyelitis and non-union		2
Foreign Bodies present		7
Definite sequestra present		32
Cases originally having complete fracture		32
Cases originally having incomplete fracture or bone wound		14
Amputation stump of Femur		8
Tibia		1
Humerus		1
Lesion in Femur		12
Tibia		9
Fibula		3
Humerus		8
Radius		1
Ulna		4
Scapula		3
Ilium		2
Sacrum		1
Ribs		1
Ankle and Foot		4
Wrist and Hand		3

The presence of "thru and thru" tunnels, cavities or simple fistulae probably depended on the extent of the original injury and the very early treatment. (See Plate 1).

In 6 cases it was stated that the superficial scar was unhealed and in all of these the presence of bone disease could not be demonstrated but the surface scar apparently broke down very easily from mild trauma or possibly from a still present but low-grade infection.

The periosteoma in each of the 2 cases noted was a definite fungus-like outgrowth from the periosteal surface of the femur. One was a case of simple fracture that became infected after a

plating operation (more than a year before) and the other was an osteomyelitis from a severe contusion. In the latter case there was a tunnel thru the outgrowth and after supposedly complete removal a recurrence about the size and with a similar tunnel was seen. It would seem that some of the periosteum with attached bone cells must have been left at operation. Rocher has described this condition under the name of Traumatic Periosteoma and considers it due to a contusion or a grazing wound of the periosteum resulting in a fungous-like bony growth with a sinus in which bone can be felt with a probe. He claims that very careful complete removal is necessary for a cure.

In the 4 cases listed as having a trough, the X-ray examination showed that radical bone operations had been done and that the cavities had been very well obliterated. (See Plate 2). In

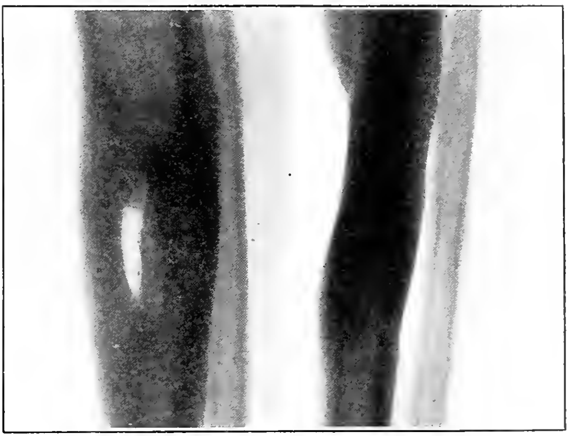


PLATE 1.

A case of thru and thru tunnel in the tibia as seen in a lateral view. No evidence of disease. Many small foreign bodies present. There was a sinus which closed a few days after admission and remained closed during the two months that the patient was under observation.

PLATE 2.

A case showing a shallow trough in the tibia which was made at a previous operation. There was a superficial wound which closed without operative treatment.

one of these cases there was a sequestrum present which had to be removed.

The two cases of non-union with disease were both of the ulna and are merely being observed until a later date for bone-graft operations. (See Plate 3).

It was noted that 7 cases showed foreign bodies present but it was only in two that they apparently caused prolongation of the lesion. In all the cases the foreign bodies were shell fragments.

PLATE 3.

Non-union of ulna wih loss of substance, a foreign body still present and some disease in the end of the lower fragment.

PLATE 4.

A small sequestrum present in a tunnel in the humerus. The wound closed a few days after its removal. Four weeks later the patient fell and fractured both of the tunnel walls.

Sequestra were found in approximately half of the cases and did not seem to occur more often in any one bone than in another. I have not very exact figures as to how many of the cases gave a history of spontaneous discharge of one or more sequestra but it was a large proportion. (See Plate 4).

In 5 of the amputation stumps there was spur formation but this same condition was seen in a similar number of stumps that were observed which did not have any bone disease, so I infer that there is no connection between disease and spurs of this type.

The aims in the treatment of compound fractures and bone wounds at the time of injury are as follows:

1. Removal of foreign bodies, free and mobile bone fragments.

2. Obliteration of dead spaces.

3. Prevention or removal of infection.

4. Efficient reduction, splinting, etc., as indicated.

Undoubtedly, most of the cases that we see now could have been prevented had all of these aims been achieved. It is impossible to know in some of the cases which of the points in the treatment were at fault. Many of the cases were, of course, treated under circumstances which were far from ideal.

At a somewhat later stage when the osteomyelitis becomes chronic the problem is then somewhat the same, namely the removal of remaining foreign bodies, sequestra and infection, and the obliteration of cavities, tunnels and fistulae. Here we must open the bone wide or we will again have sequestrum formation because there is thrombosis of the nutrient vessels, exudate and necrosis, followed by osteo-sclerosis and persistent civity even if the sequestra does get out. There may not be a sequestrum if the infection is mild and then the necrotic bone may be replaced by new bone thus forming a cavity with hard walls incapable of filling-in by regeneration.

The real chronic stage with which we are dealing is somewhat different and considerably more difficult to cure. The pathological condition is much the same but with the addition in most cases of extensive osteo-sclerosis. Dehelly and Loewy lay particular stress upon the necessity of effacement of cavities, especially in fractures. They conclude that if this is done immediately after the wound or during the period of acute infection or

when consolidation has occurred it will not be necessary in the late or fistula period. The earlier it is done the better the opportunity to clean up the infection and the less chance of sequestrum formation, spread of infection and large cavity formation.

The removal of fragments may be controlled by X-ray and it is best to remove all free and mobile adherent fragments and detached periosteum. Removal of too little prevents disinfection but on the other hand the removal of too much increases the chances of pseudarthrosis.

In the type of chronic osteomyelitis of idiopathic origin or from trauma which does not cause an open wound, the infection is more liable to spread as there is no outlet and hence it does not become walled-off. In this fistula type the infection is said to be very superficial by Chutro because of the presence of the outlet and also a so-called lymphatic blockade. Others claim that it is often very deep and may even extend several inches from the surface.

The dense osteo-sclerotic bone formed about a cavity or tract presumably helps in preventing the spread of infection and it would therefore be unwise to remove it, but on the other hand if we hope to get good blood supply, new bone production and conversion of the cavity into a trough, it is certainly essential to take it away. In children bone evolution is not complete and we may see a remarkable growth of bone to fill a cavity or as replacement after a sub-periosteal resection. In adults a cavity will often be filled with fungosities which can wall off the infection and keep it superficial but cannot obliterate the space. If there is mild infection before the stage of osteo-sclerosis it acts as a stimulant to bone production and filling-in of the cavity may occur. If the sclerotic tissue is already present we may simulate the former condition by removing it.

In passing I would like to mention a case in this series which came in with an acute infection under a scar and from which a sequestrum was removed. It was in the upper end of the humerus and X-ray showed a complete tunnel thru the bone. The wound healed very rapidly and four weeks later the patient fell on the ice, striking his shoulder and he returned to us immediately with a simple fracture thru both of the lateral tunnel walls.

There was no displacement and in six weeks he had firm union. The interesting features of the case were that there was pain, crepitus and false motion but no evidence of swelling, ecchymosis or other local reaction. (See Plates 4 and 5). A similar case also came in with a simple fracture of the tibia at the site of an old compound fracture with osteomyelitis. There was loss of substance of about an inch-and-a-half but this defect had been filled in by a bridge of new bone approximately one-half the size of the tibia normally. (See Plates 6 and 7). The symptoms and signs were the same as in the other case and I believe that the absence of local reaction was due to the great amount of scar tissue and sclerotic bone at the site. It was interesting to note that this amount of trauma did not cause a recurrence of active disease, and that union occurred in a reasonably short time.

PLATE 5.

Same patient as Plate 4 showing the fracture thru the tunnel walls which was caused by a fall four weeks after the wound closed. Union was firm in six weeks.

PLATE 6.

Antero-posterior view showing a simple fracture from a mild trauma thru newly formed bone which had bridged a gap in the tibia.

In a femur stump which I re-amputated the entire end of the bone was soft and it was easily removed with bone-cutting forceps. There was no sclerotic bone and no sequestrum but merely a superficial necrosis. Primary post-operative healing occurred rapidly.

In flat bones, such as the scapula and ilium, a hole thru the bone is not in itself a bad condition as the soft parts on either side fall in and do not leave any dead space.

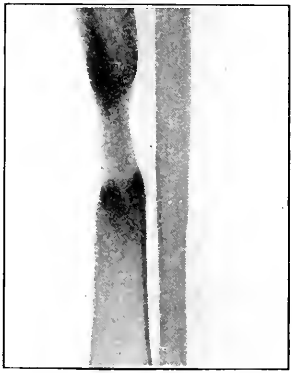


PLATE 7.

Lateral view of same case as Plate 6 showing how the inch and a half of lost substance had been replaced by new bone. The fracture is not well seen in this view.

The methods of treatment that have been tried are almost too numerous to mention but practically all have the same result in view, namely; the removal of the infection and any remaining foreign bodies or sequestra and the obliteration of the bone cavity with a filling-in of the resulting space. Often merely incision and drainage or removal of a sequestrum is sufficient. Sometimes curetting or attempts to sterilize the field and remove all affected bone and soft parts.

To obliterate a tract or cavity one may merely remove the edges and underlying bone and convert the defect into a saucer-

like shallow depression or trough. If there is a tunnel one of the walls may be removed, usually the weakest or the most accessible one. Some of the methods that have been used to fill in the remaining defect are, to cut bone wedges from the sides of the opening and force them down in with some pressure, free tissue transplantation, (usually fat) tissue flaps attached by a pedicle and in this type muscle has been found best. Such a flap has also been used in cavities near the ends of long bones and in tunnels.

From previous experience I have noted that the transplantation of free fat has failed in every instance. Experience with attached muscle pedicle flaps has been much more satisfactory. Theoretically this should be the best tissue available as it is so often present in sufficient quantity near the wound, is about the most resistant tissue to infection and it has very good blood supply. Gallie has reported some cases where he has had an opportunity in later operations to observe some of these flaps and he has found them fixed in place and united to the bone by connective tissue with the bone cavity remaining as it was at the former operation but surrounded by dense sclerotic bone.

Another method described but chiefly for non-traumatic chronic osteomyelitis is to remove just enough involucrum to get out the sequestrum and then crush down the rest of it to fill the cavity and pour in 3½% tincture of iodine once a week. The filling-in of a cavity with bone chips is somewhat the same in principle. Also merely allowing the overlying soft parts to fall in or be held in by firm dressings. Others by packing the wound to get healing-in by granulations from the bottom. Still others by skin flap methods to completely line the surface of the depression or wound. I have seen a case recently which was a failure following a skin flap operation where the skin had been nailed to the bone surface. These skin methods should be avoided because we see so many cases where there is later trouble from adherent scars which frequently break down, especially from trauma often of the mildest character.

The sterile blood-clot method has been tried and good results claimed but not in very large numbers. In some cases the wound has been closed immediately with or without drainage or after a few days of treatment with various chemicals, etc.

A method of trepaning has been tried by Soresi but so far we know very little about it. He drills many small holes in the

bone overlying a cavity and believes that the drainage is improved, the bone not materially weakened and that there is a better opportunity for granulations to grow in.

The polyvalent serum of Leclainche and Vallee has been used in the form of serumized dressings to pack the wound but the results are not reported to be very gratifying as the cicatrization is not durable and there is danger of lymphangitis, erysipelas and suppuration.

The use of various antiseptics has been unsatisfactory for when one is employed that is strong enough to wipe out the infection it will cause tissue necrosis and the likelihood of new sequestrum formation, etc., thus going again thru all of the stages of osteomyelitis.

Paste, wax, and similar materials have been tried very extensively and there are still many men claiming excellent results altho the majority report otherwise. It would seem that their use is limited and that in many cases the material might merely act as a foreign body. They are used a great deal along with operative treatment and the good results obtained may be due to the latter.

Light, both sunlight and artificial, has been used and in many cases has undoubtedly been of great benefit. My experience in this method is very limited but I have seen a few very chronic sinuses close during its use.

X-ray control of the cases is of the greatest value before, during and after treatment.

Subperiosteal resection may occasionally be indicated in the upper extremity where length is not of so much importance. It is not as good in adults as it would be in children, (where bone evolution is still incomplete) and often it will be necessary to follow it with a bone-graft.

In cases of bone disease in amputation stumps a cure may be effected by simple removal of a foreign body or sequestrum and curetting but occasionally a re-amputation is necessary and may give an excellent result but should not be advocated if the shortening of the stump will affect the application of a satisfactory prothesis.

I feel certain that we all agree that in these extremely chronic cases, surgical operation is the real treatment. In most of them

it is indicated alone but possibly in a few some one of the other methods may be used in conjunction with it.

These cases have not, of course, been observed for a long enough time to deduce any conclusions as to results. However, I wish merely to mention in passing that on the last examination the following tabulation was made:

Closed	40
Condition same (not op.)	8
Apparently need further treatment	6
Too soon after operation for report	7
	61

In the longest cases this only means about 5 months so it is needless to say that any of the cases can be considered cured.

The tendency in the treatment of all of the cases was conservatism. If from the history, examination and X-ray findings, a case was apparently improving it was observed for a while and I attempted to aid nature in closing it by simple dressings, rest of the part and in some cases massage and other physio-therapeutic measures when indicated.

In a few cases, incision and drainage of an acute flare-up with removal of any foreign body or sequestrum, followed by simple dressings was sufficient. In some this was done along with a gentle curettment. In others with acute infection present they were merely opened and drained and after several days when the acute signs cleared up the real operation was performed, namely; sequestrectomy and cavity obliteration.

When a definite cavity, tunnel or bone fistula was found, the defect was converted into a shallow trough and closure was aimed at by approximation of the overlying soft parts. There were no cases in the series where a flap was necessary but had there been I surely would have used an attached pedicle muscle and fascia flap, for the results in previous cases fully warranted such a procedure. When a tunnel or cavity is present near or at the epiphysis and hence in the region of a joint it is usually necessary to employ a flap, except, of course, cases where the joint has been completely obliterated.

In most instances the wound was closed in layers with a rubber tube drain to its deepest point and unless infection developed this was removed in two days. If there was evidence of much in-

fection present the wounds were left open and treated by the Carrel-Dakin method.

Some cases did not entirely close because they were allowed to get up too soon but when they were put back in bed the healing went on rapidly. A few very sluggish superficial wounds would not seem to close at all until they were strapped with adhesive plaster the same as is done in certain ulcers. It was routine in all cases to excise sinuses and as much of the scar tissue as possible especially when the wound was being closed at the same time. Also when there was an adherent scar or one that broke down readily or failed to heal, or when there was merely a tract in the soft parts not extending down to bone.

Three of the patients listed as requiring further treatment had been operated upon previous to our service and the operation in each case was a very extensive one on the upper end of the femur. In one there was definite sequestrum, one had many fragments of shell still present and the third had apparently an extension of the necrosis. These three patients had been operated upon by Dr. Chutro more than 6 months before I made the above notes on their condition. There was a fourth case of the same type which I included in the number of cases closed, but it did not look any too well at this time as there was a large scar adherent to bone and considerable tenderness, redness and infiltration.

The other three apparent failures were as follows: One had a sequestrum apparently not found at operation, one had a periosteoma recurrence as I have mentioned before (See Plate 5) and the third had a new sequestrum develop later. This last condition might have been expected for at the original operation I removed a few small sequestra and one very large piece of necrotic bone which was still attached at one end.

In all of the cases physiotherapy has been used whenever possible. It is certain that it has shortened the period of disability in most cases by keeping up the tone of the muscles and preventing loss of function or even improving function in neighboring joints.

I feel that a word must be said about occupational therapy and recreation. We all know what these mean in most any orthopedic condition where the course is chronic. The men with

whom we have been dealing are all Ex-Service men and they have all been thru many hardships, long periods of disability and confinement in hospitals and are anxious to get back to their regular lives. It is most essential to keep them busy and happy and satisfied, and I am sure that everyone who has worked with them will agree that they are most willing to co-operate and this is, of course, an important and necessary feature.

It is needless to mention before closing that nothing new or original is claimed in the treatment of this condition, but I consider that it is such a large and important subject that a great deal of stress should be laid upon it and that it is well to keep it as an open book before us. Also the report of the observations and study in such an interesting series of cases should not be passed by without note.

I do wish to repeat that I believe conservatism is the keynote in the treatment and from the observation of these cases it has been very emphatically shown that the results in the cases which have had very radical .treatment are no better than in those which have had the form of treatment employed in this series. Also that those treated by radical methods often have late developments of serious character such as non-regeneration of bone, increased liability of fracture, etc. Many reports have been made on early cases of chronic osteomyelitis but comparatively few on this extremely chronic fistulous type. I think that we are all going to have the opportunity to study cases of this character for some time and that if all the results will be recorded we may arrive at some more definite conclusions and probably find the ideal treatment or at least emphasize the importance of avoiding many of the harmful radical procedures that have been tried and found wanting. Never before has there been an opportunity to observe this condition in such a large number of cases as have resulted from the War and, of course, these have not been followed for a very long time. I feel sure that everyone will have the same experience that I have and will see many of the cases that have been reported cured, return with further trouble.

CONCLUSIONS

1. Chronic Osteomyelitis is seen in a seriously large number of patients who have had bone injuries.

2. It is extremely chronic in its course and it is practically impossible to determine when a case is cured as some may light-up many years after they have been considered finished.

3. Efficient early treatment would lessen the chances of this chronic condition or possibly entirely prevent it.

4. That the methods tried in the real chronic stage are not very satisfactory, is evidenced by the large number and the variable results claimed, and the fact that we still see so many uncured cases.

5. Operative treatment is indicated in practically all of the cases.

6. The aims in the treatment are:

(a) To remove any remaining foreign bodies, sequestra, etc.

(b) To remove the infection.

(c) To obliterate the cavity.

(d) To fill in the space.

7. The space is filled most satisfactorily by the overlying soft parts if the trough can be made in a situation where plenty of tissue is available. If flaps are necessary muscle has been found best.

8. Conservative treatment rather than radical should be employed.

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A PROTRACTOR FOR MEASURING ROTATION OF JOINTS

WILLIAM ARTHUR CLARK, A. M., M. D. PASADENA, CALIFORNIA

This instrument is a half circle cut out of zinc, aluminum or other rigid material, marked with the degrees of the half circle arc from 0° to 180° and mounted on two upright pieces so that it is vertically adjustable. It is made large enough to go over the knee which is the largest part it is required to arch over. By means of the vertical adjustment it is set at the desired height above the flat surface upon which the limb rests so that the diameter from 0° to 180° passes at right angles through the axis

FIG. 1. Neutral position of the forearm, (90°). For use on the right arm or leg, reverse the protractor and read from the proximal side.

of rotation. The zero end of the arc is placed toward the median body line so that inward rotation is always toward 0° and outward rotation toward 180°. In stating the amount of rotation it is not necessary to specify internal or external but merely to state the two limits, e. g., rotation 40° to 160°. This is one of the details of a system of joint measurements described in a previous paper.[1]

[1]Clark, William Arthur. A System of Joint Measurements. The Journal of Orthopedic Surgery. 2:687, December, 1920.

*The photographs were made by the photographic studio of the Mayo Clinic.

The reading is taken by sighting along the radiating lines on the wide surface of the protractor, the observer's head being placed so that the eye comes almost in the same plane as the protractor and at sufficient distance to lend perspective. By moving the head a radiating line will be found which coincides with the plane of the rotated limb. (90° in Fig. 1) For the forearm this plane is that which passes through the radial and ulnar

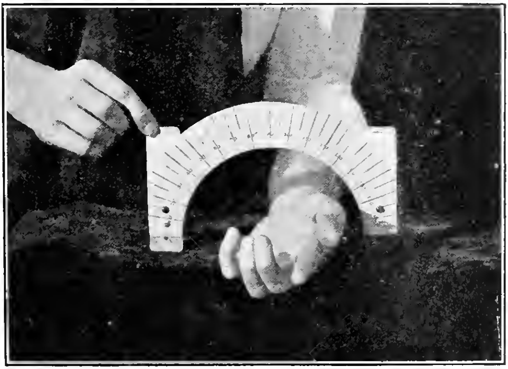

FIG. 2. Rotation (supination) to 165°. By loosening the upper screws on either side the protractor can be moved up or down on its supports.

styloids. For all other parts it is the antero-posterior plane. It is necessary to make this exception for the forearm because the anterior projection of the antero-posterior plane would pass out of the half circle on complete pronation. Also because the axis of rotation of the radius does not coincide with the long axis of that bone but passes through the lower end of the ulna and the head of the radius.

GIANT-CELL TUMOR IN THE KNEE JOINT: REPORT OF A CASE

BY PIO BLANCO, M. D.

FELLOW IN ORTHOPAEDIC SURGERY, THE MAYO FOUNDATION, ROCHESTER, MINNESOTA.

Case A339505. Mrs. P. B., aged 30, came to the clinic in November, 1920 complaining of a swollen and painful left knee of one year's standing. Four years before she had sustained an injury to both knees from a fall. There was no immediate disability, but a small tumor appeared on the left knee and gradually attained a diameter of 4 cm. There had been no locking, swelling or local tenderness of the joint at any time, and it was painful only if used.

FIG. 1. CASE 339505. Low power photomicrograph of giant-cell tumor.

Examination revealed a healthy young woman, 5 feet, 5.5 inches tall and weighing 167 pounds. Her blood pressure, pulse, and temperature were normal. There was no leukocytosis and the Wassermann reaction of the blood was negative. A roent-

genogram of the left knee was negative. The smooth, round, movable, firm tumor could be felt on the outer side of the ligamentum patellae. Motions of the knee joint were normal.

November 9, 1920, Dr. M. S. Henderson removed the tumor which was lying in the capsule of the joint and was intimately associated with the infrapatellar pad. An area of discoloration in the tumor suggested the presence of a fairly recent hemorrhage. Microscopic study of the tissue revealed giant-cell tumor of the xanthic type. The patient's convalescence was uneventful.

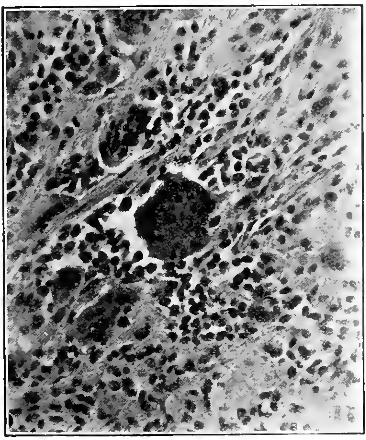

Fig. 2. Case 339505. High power photomicrograph showing the structure of the giant cell.

Discussion

The pathologic changes observed in the tumor are analogous to those found in the xanthic giant-cell tumors reported by Broders. Figure 1 is a low power photomicrograph of the tissue and Figure 2 shows the structure of the foreign-body giant cell highly magnified. Broders has reviewed the literature of this type of tumor and has reported a series of seventeen cases observed in the Mayo Clinic. These tumors are benign and may be considered a type of granulation-tissue tumor resulting from hemorrhage. The hemorrhage may be caused either by infection or trauma. The polynuclear giant cells observed morphologically resemble the osteoclast and their function is probably phagocytic. As a rule these tumors are located on the extremities and are commonly associated with a tendon or its sheath. Not to my knowledge has their presence in the joints been reported.

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Arthur J. Gillette M.D.

Died at St. Paul, Minnesota, March 23, 1921.

ARTHUR J. GILLETTE

On March 24th I received the following telegram:

Arthur J. Gillette passed away last night.
Katherine Gillette.

Just four weeks before he wrote me: "I am in better health than I have ever been and am not going away this winter."

What the physician's diagnosis was I do not know. It does not matter. He really died from over-work and untiring devotion to his patients and his family.

A few years ago his vision became dim from high blood-pressure. His physician commanded complete rest. He went away for a little while and then returned, and thought he was taking things very easily when in reality he was working harder than any of the rest of us when we are busy. For more than 20 years he has treated more pay patients daily than any two orthopedic surgeons of whom I know.

In 1889 he came to New York and served for a year as Resident Surgeon of the New York Orthopedic Dispensary and Hospital. He was a charter member of the American Orthopedic Association. He was responsible for the establishment of the first State care of cripples, which culminated in the Minnesota State Hospital for Crippled and Deformed Children of which he was the Chief Surgeon from the beginning of the work until his death. For a quarter of a century he was the leading orthopedic surgeon of the Northwest. He was an essentially conservative surgeon; nevertheless he was among the first to operate for ununited fracture of the neck of the femur. The keynote of all his work was good sense. He dealt in facts, and had no time for dreams, and no patience with shams.

Arthur Gillette was a real man; and I am proud to say that he was my friend for 32 years.

JOHN RIDLON.

ARTHUR J. GILLETTE

In the death of Dr. Arthur J. Gillette, Minnesota and the Northwest have suffered a great and enduring loss. He was a pioneer in the field of Orthopedic Surgery and when that specialty was still in its infancy he brought Minnesota to the front rank in this field. He caused Minnesota to see, appreciate and attack the problem of the crippled child a long time before most of the states realized that such a problem even existed. As a result—there stands today the model Institution at Phalen Park—a monument to its founder and a dispenser of past, present and future blessings the value of which can never be measured in terms of money alone.

It is unnecessary to write of Arthur Gillette's prominence in the field of Orthopedic Surgery; of the many honors bestowed upon him by the associations of which he was listed a member; of his numerous and able contributions to the literature of his specialty. All of that is a matter of record and is well-known.

In him there passed away a man; a real and lovable man. He was of unexampled buoyancy and good cheer which radiated from him and contributed not a little to his great professional success. He was of wide culture and interested in many of the fine things of life outside of his profession. To the younger members of his profession he was always a wise and honest counselor and a good friend. He excelled as a teacher; his enthusiasm was contagious. His lectures were masterpieces because he was a master of his subject. Those who knew him best loved him most.

EMIL S. GEIST.

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NOTES AND NEWS

Dr. C. F. Painter of Boston, who has been Dean of Tufts Medical School for some years, has resigned. Dr. Painter will continue his duties in Tufts as Professor of Orthopaedic Surgery.

Dr. Richmond Stephens of New York has announced the removal of his office to 119 West 58th Street.

AMERICAN ORTHOPEDIC ASSOCIATION

Annual 35th Session

Boston, Mass., June 2, 3, 4 and 6, 1921

Preliminary Programme

THURSDAY

June 2, 1921

9:00 A. M. **Presidential Address.** Dr. Robert B. Osgood.

9:30-11:00 **Congenital Hip Commission Report.** Drs. Goldthwait, Adams and Willard.
Discussion to be opened by Dr. E. H. Bradford and Dr. H. L. Taylor.

11:00-11:30 **Congenital Dislocation of the Hip.** Dr. John Ridlon.

11:30-12:00 **Arthroplasty.** Dr. Vittorio Putti.

12:00 **Executive Session.**

1:00-2:00 **Luncheon.**

2:00-2:30 **Cancer.** Dr. R. B. Greenough.

2:30-2:50 **Infantile Paralysis.** Dr. R. W. Lovett.

2:50-3:20 **A Clinical and Experimental Study of the Application of Free Transplants of Fascia and Tendon in Orthopedic Surgery.** Dr. W. E. Gallie and Dr. A. B. LeMesurier.

3:20-3:40 **End Results in the Operative Procedures for Infantile Paralysis with Special Reference to Tendon Transplantation at the Widener Industrial Training School for Crippled Children.** Dr. A. Bruce Gill.

3:40-4:00 **Some Views on the Immobilization Treatment of Septic Arthritis of the Knee.** Dr. F. R. Ober.

4:00-5:00 **The Teaching of Orthopedic Surgery.** Dr. Nathaniel Allison.

EVENING SESSION—8:00 P. M.

Ten-Minute Addresses

A Historical Review of Surgical Methods in the Treatment of Spine Injuries. Dr. H. W. Orr.

Amyotonia Congenita of Oppenhiem with Case Report. Dr. Charles A. Stone.

Lengthening of the Quadriceps Tendon for Mobility of the Knee Joint—End Results and Moving Pictures. Dr. G. E. Bennett.

Treatment of Fractures of the Femur. Dr. Frank E. Peckham.

Sympathetic Segmental Disturbances, or the Association of Visceral Diseases with Minor Spinal Curvatures of the same Sympathetic Segments. Dr. Henry Winsor.

Abstract:

After the examination of fifty animals and fifty human skeletons, minor curvatures of the spine were observed in the majority; after summarizing the results of fifty necropsies, visceral diseases were found to be secondary to minor curvatures of the vertebral column, sympathetic irritation causing vaso-motor spasm of the organs, the ischemia thus produced resulting in a predisposing factor of disease. Temporary curvatures produced in the spines of cats caused collapse of the great vessels and diminution of cardiac movement. Dissections of the sympathetic showed that movement of the spine causes stretching and relaxation of the sympathetic.

FRIDAY

June 3, 1921

9:00-10:00 **Sur un nouveau traitement de la paraplegie Pottique. Sur l'osteo-chondrite infantile de la hanche. (Maladie de Legg-Calve.)** Dr. Jacques Calve.

10:00-11:30 **Commission Report on Ankylosing Operation on the Spine.** Drs. Brackett, Rugh, Baer.

11:30-11:50 **Army Experiences with Tendon Transferences—End Results.** Dr. Clarence L. Starr.

11:50-12:10 **Operative Treatment and End Results in Disabilities of the Arm and Shoulder.** Dr. Arthur Steindler.

12:10-12:30 **Arthroplasties—End Results.** Dr. W. S. Baer.

12:30-12:50 **Arthroplasty of the Knee—Report of Cases.** Dr. W. C. Campbell.

1:00-2:00 **Luncheon.**

Symposium on Fractures

2:00-2:30 **End Results in Fractures of the Hip.—Fracture Service.** M. G. H. Dr. D. F. Jones and Associates.

2:30-3:00 **Fractures of the Elbow in Children.** Dr. J. S. Stone.

3:00-3:30 **Bone and Joint Fractures—Knee and Ankle.** Dr. G. W. Hawley.

3:30-4:00 **End Result Fractures—Lower Leg.** Dr. E. W. Ryerson.

4:00-4:30 **End Result Fractures—Femur.** Dr. M. S. Henderson.

4:30-5:00 **Operative Treatment of Epiphyseal Separation.** Dr. David Silver.

SATURDAY

June 4, 1921

9:00-10:30 **Commission on Stabilizing Operations upon the Foot.** Drs. Cook, Fitch and Stern.

10:30-10:50 **The Stabilization of Paralytic Feet.** Lantern Slides. Dr. Michael Hoke.

10:50-11:05 **Report of Results of Cuneiform Osteotomy of the Neck of the Astragalus in Paralytic Talipes Equino Valgus, and Varus Plus Pes Cavus.** Dr. Compton Reilly.

11:05-11:20 **Congenital Club Feet (General and Present Methods in the Treatment of).** Dr. Eben W. Fiske.

11:20-11:40 **The Treatment of Sprain—Fracture of the Tubercle of the Tibia in Adolesence (Osgood-Schlatter Disease).** Lantern Slides. Dr. Robert E. Soule.

11:40-12:00 **Peripheral Nerve Injuries.** Dr. Harry Platt.

12:00 **Executive Session.**

P. M. **Canton.** Massachusetts Hospital School for Crippled and Deformed Children.

MONDAY

June 6, 1921

A Clinical Day is being arranged, but the details will not be available before the final program is issued. It will be necessary for any who have secured reservations at hotels from the 2d to the 5th of June and desire to

stay through the sixth to secure such additional reservation through the Hotel Committee of the American Medical Association. It can not be done through communication with the hotel direct. This committee can be reached by addressing the Committee of Arrangements at 8 The Fenway, Boston.

Papers Submitted

And to be Read by Title

The Pathology of Two Unusual Cases of Contracture. Dr. Sydney M. Cone.

A Report of Three Cases of Avulsion or Fracture of the Lesser Trochanter. Dr. C. F. Eikenbary.

The Control of the Anterior Arch in Selected Cases of Morton's Toe. Dr. Roland C. Meisenbach.

Certain Inconsistent Deductions from the Surgery of the Great War. Dr. Fred H. Albee.

The Treatment of Caries of the Spine. Methods of Recording Scoliosis. Studies in Spinal Side Flexibility and Congenital Dislocation of the Hip. Dr. E. H. Bradford.

An X-ray and Anatomical Study of the Lumbo-Sacral Region. Dr. J. A. O'Reilly.

CANDIDATES' THESES

Tendon Transplantation for Musculospiral (Radial) Nerve Injury. Dr. R. W. Billington, Dr. D. F. Clark.

Hypertrophic Bone Changes in Tuberculous Spondylitis. Dr. R. B. Cofield.

Report of the Orthopedic Examination of 711 Freshmen at Yale University. Dr. R. J. Cook.

Substituting Felt for Steel Arch Supports. Dr. Walter G. Elmer.

Simultaneous Hydrops of the Knees. Dr. H. J. Fitz Simmons.

A Clinical Study of the Pathology of Osteomyelitis. The Painful Traumatic Shoulder. Dr. Alexander Gibson, Dr. Ellis W. Jones.

Fracture of the Spine. Dr. Samuel Kleinberg.

A Study of 208 Cases of Lower Back Pain. Dr. J. R. Kuth, Dr. Philip Lewin.

The Effect of Faulty Skeletal Alignment Upon the Eyes. Dr. Charles L. Lowman.

Skeleton Spinal Brace. Dr. G. D. Marshall.

The Treatment of Paralytic Flat Feet. Dr. Leo Mayer.

On Delayed Union and Non-Union of Fractures. Dr. J. A. Nutter.

Low Back Pain—A Clinical Study of Its Cause. Dr. J. T. O'Ferrall.

Early Symptoms of Spinal Cancer. Dr. E. D. Oppenheimer, Dr. W. B Owen, Dr. W. B. Preston.

The Curative Play System of the Children's Mercy Hospital of Kansas City, A Preliminary Report. Dr. R. M. Schauffler.

Osteomyelitis Following War Injuries. Dr. Richmond Stephens.

Arthrodesis Sacro Iliac Joint; a New Method of Approach. Dr. M. N. Smith-Petersen.

Astragalectomy and Backward Displacement of the Foot. An Investigation of Its Practical Results. Dr. A. Whitman.

Early Weight Bearing in Amputations of the Lower Limb. Dr. P. D. Wilson.

Current Orthopaedic Literature

Delay of Healing of Fractures and the Influence of War Nutrition. U. Hammer. *D. m. W.* 1920. 27. S. 728-40.

The retardation of callus formation has been noticed in a considerable number of cases. No definite local and constitutional causes could be determined except undernourishment with its resultant latent damage to the skeleton. The damage does not express itself symptomatically or roentgenologically but manifests itself only as soon as bone is called upon to form callus in the healing of fractures.

The author concludes that this phenomenon is explainable by the deficient feeding of war. As treatment he recommends hot air, massage and mechano therapy locally and calcium and phosphorus preparations internally, but expresses doubt as to the efficiency of this treatment.—*A. Gottlieb, M. D., San Francisco, Calif.*

Quadriceps Atrophy. Arthur Stoffel. *D. m. W.* 1921. 5. S. 126.

This common and troublesome affection is overlooked and disregarded very frequently although it leads to marked functional disability. The author reports four cases and draws attention to its importance. The primary factor may be a slight injury or insignificant infection of the knee joint; the atrophy sets in as early as one week after it and lasts many years after the primary cause has been abolished. This atrophy is very troublesome and obstinate to treatment. The actual causation of this phenomenon, the quadriceps atrophy, still requires explanation; inactivity alone cannot account for it since it does not occur in other muscles except, in rare occasions, in the deltoid. The author advocates faradisation, massage and mechanotherapy as treatment. Detailed reports of four cases follows.—*A. Gottlieb, M. D., San Francisco, Calif.*

Comparative Frequency of Dental Caries Among the Tuberculous. P. Fargin Fayolle, *Presse Medicall*, Jan. 15, 1921.

Fayolle points out the importance of taking into account the decalcifying tendency that goes with active tuberculosis.

He made a study of a series of patients and found the percentage of tooth damage to be 33 in the tuberculous as against 28 and 20 in general medical and surgical cases.

BONE GRAFTING: STUDY OF A SERIES OF CASES OPERATED IN U. S. ARMY HOSPITALS. By Dr. J. B. Walker, New York City, N. Y. *Annals of Surgery*, Jan. 1921.

The bones involved were:

	Grafts	Plates	Kangaroo Tendon	Wire
Humerus	118	19	13	14
Radius	161	5	4	8
Ulna	105	8	7	....
Radius and Ulna	54	11	3	3
Femur	46	87	12	10
Tibia	77	34	7	14
Fibula	9	....	.	...
Tibia and Fibula	41	25	6	5

In order to obtain the best results sufficient time must be allowed to elapse between the injury and the operation for the complete subsidence of the original infection, and the above figures show a more favorable recovery has followed the late rather than the early operation; that is to say, over rather than under two hundred days after injury. It is reasonably safe to operate during the fourth month after complete healing has occurred.

Grafts, autogenous, taken from the tibia have proved the most efficient material for bone grafting for fractures of the long bones, on account of its characteristic strength. They are best made with the saw and exact coaptation of parts of the graft to respective parts of the host bone must be secured.

While many of these records are as yet too incomplete to give the final end-results, yet sufficient evidence has been secured to prove that bone grafting is the most efficient method for non-union of fractures and very favorable results can be obtained in the largest percentage of cases.

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The Journal of Orthopaedic Surgery

BACKACHE AND ANATOMICAL VARIATIONS OF THE LUMBO-SACRAL REGION

ARCHER O'REILLY, A. B., M. D. ST. LOUIS

Goldthwait first emphasized the role of the sacro-iliac joint as a cause of backache; later the importance of the transverse process of the fifth lumbar and other anatomical variations has been noted.

Our knowledge of the bony structures in lumbo-sacral regions is still far from complete. Text book descriptions of this region are meagre. In the last few years, however, quite an extensive literature has developed, but this deals mostly with individual cases and with the question of sacro-iliac displacement.

In studying the X-ray plates of individual cases one is impressed with the anatomical variations that one sees. In order to learn whether these variations were as common as they seemed, I have undertaken this study.

X-ray plates of three hundred patients with backache were examined. Tracings were made from one hundred and ninety-nine. The majority of the cases were those seen in the Dispensary of the Washington University Medical School. A few were private patients. None of the plates studied was selected, so that the plates represent the general run of cases seen in the Clinic. The ages and occupations were tabulated in 257 cases. There were 163 men and 94 women. The ages were from 17 to 70, the greatest number occurring between 31 and 50 years in men and between 21 and 30 and 41 to 50 in women. (Table I.) There were 65 different occupations. Housewife was most frequent in women; miner and laborer the most common in men. (Table II.)

Tracings were made of the X-ray plate in 199 cases, and these were studied for variation in the sacro-iliac joints, the transverse processes of the fifth lumbar, and other changes.

These tracings could be divided into three definite types. (Fig. 1.) In Type I the sacrum is fairly high between the ilia. It is fairly broad and the upper border extends to, or a little beyond the line of the iliac crests, before it curves to form the line of the sacro-iliac joint. The crests of the ilia curve at an angle of about 45°. The distance between the posterior portion of the crest and the line of the sacro-iliac is fairly broad. For the remainder of my paper, I shall, for brevity, refer to this as the sacro-iliac. This is a mixed type and is found in both males (57)

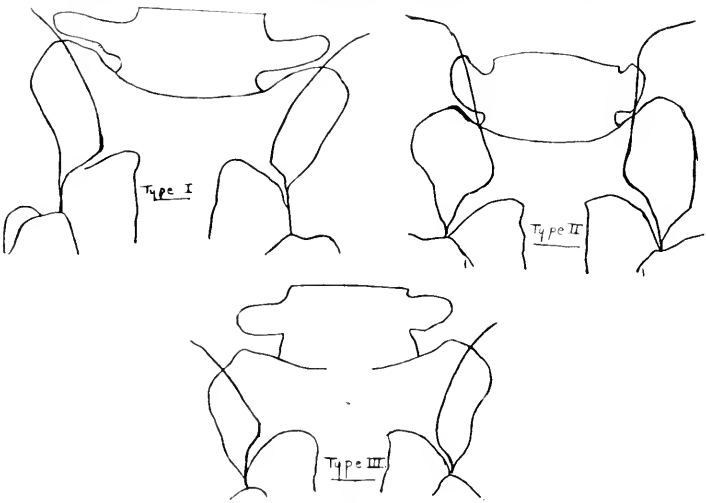


FIG. 1.

and females (29). It is also a transitional type, as some of the cases show characteristics of the other types. Fig. 2. (Table 3.)

Type II (Fig. 1) is very distinctive. The crests are almost vertical. The outlines of the posterior spines of the ilia are sharp and angular. The general impression is that the sacrum is narrow and is set low between the crests. The line of the sacro-iliac is well beyond the shadow of the crests and the distance has a tendency to asymmetry. The sacro-iliac may be

either broad or shallow. This is almost exclusively a male type. (Fig. 3)

Type III somewhat resembles Type I, but the sacrum is wider; the curve of the sacro-iliac begins before it crosses the shadow of the ilium, so that there is a distinct notch, as shown in the diagram. In Type III, the shadow of the sacro-iliac is more shallow than in Types I and II. This is a female type; there were 35 women and only 5 men. (Fig. 4)

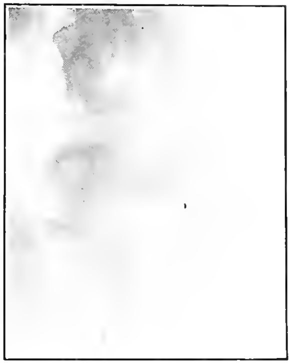


Fig. 2.

All these types show some variations and many irregularities. These may be seen in the illustrations. In all cases four measurements were made: (a) The distance between the points where the shadow of the crests of the ilia crossed the shadow of the ala. (b) The distance between the sacro-iliacs. (c) The length of the right sacro-iliac from point a. on the right side to the lower end of the sacro-iliac; (d) The same for the left sacro-iliac. Line (a) was selected as it seemed to give a more constant point. It does not give the accurate measurement of the width of the upper portion of the sacrum; it is fairly constant, however, and is of value in comparing the measurements in each case.

These measurements showed marked variations running from 0.1 cm. to 3.0. (Table 4) Table 4 shows the variations in width of Types I, II and III.

In the sacro-iliac measurements there were variations in the with between the right and the left from 0.1 cm. to 1.2 cm. (Table 5.)

I do not believe that these measurements prove anything, except that there is considerable variation on the two sides. Some of this irregularity might be due to variation in the position of the tube, but the X-rays were all taken in a standard position with the tube at a point midway between the anterior superior spines of the ilium.

The study of the transverse processes of the fifth lumbar was most interesting, as these showed the greatest variety in size and

FIG. 3.

FIG. 4.

shape. They might be roughly divided into three general types, as shown in Fig. 6,—the straight type, (1) the bulbous type (2) and the large fan-shaped type (3). (Fig. 5)

Figure 6 shows the tracings of various types of transverse processes given in the order of their frequency. The number at the bottom shows the number of times each occurred. As there were 199 cases there were 398 possibilities. Number 1 might be called the normal process. Number 2 is a very interesting type. As the tracing shows, in a number of cases the lower border seems to conform to the shape of the iliac crest, suggesting that

it is in close proximity to the crest and that its shape has been modified by it. As can be seen, the others are modifications of the three types.

Figures 7 and 8 show tracings of twenty-four types which occurred less than ten times. Some are similar, but each shows some difference, and they are shown to emphasize the great number of variations and varieties seen.

Fig. 9 shows bifid process.

In only 53 of the 199 cases were the processes alike on both sides, and most of these showed a very definite asymmetry. (Table 6)

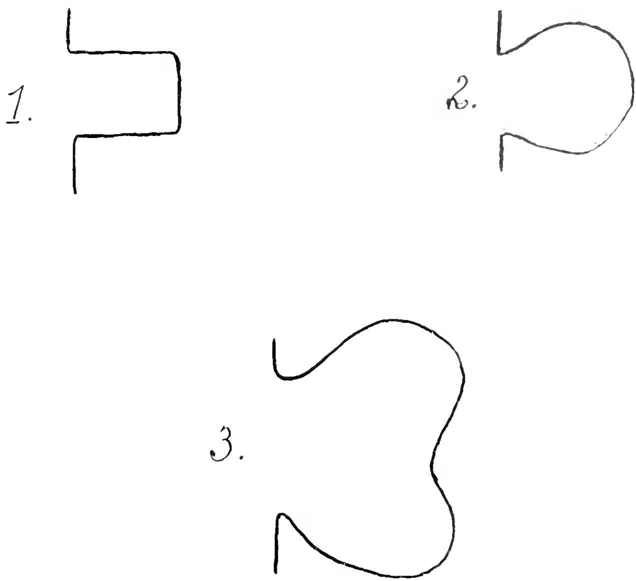


FIG. 5.

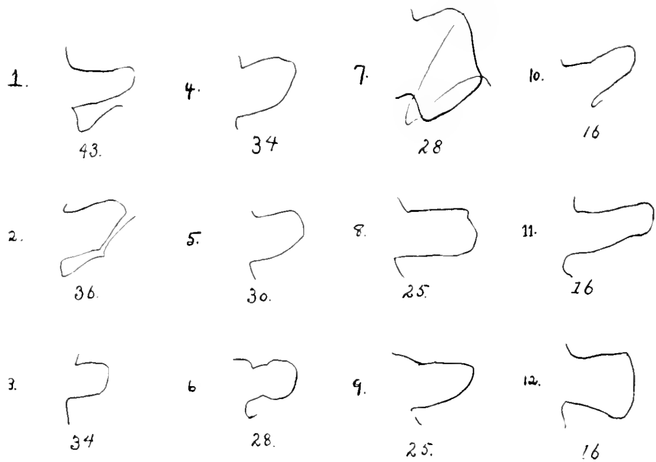

1.
43.
4.
34
7.
28
10.
16
2.
36.
5.
30.
8.
25.
11.
16
3.
34
6
28.
9.
25.
12.
16

FIG. 6.

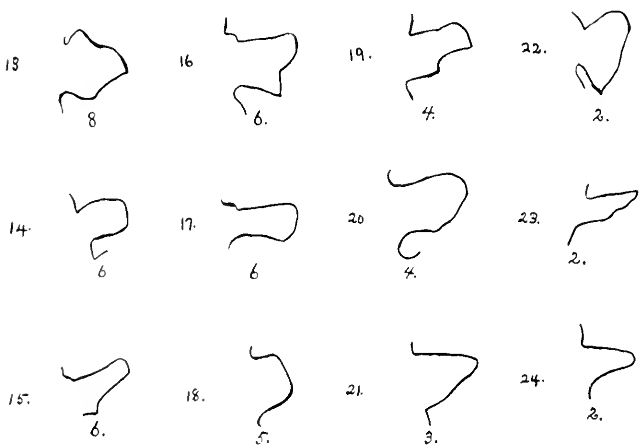

13
8
16
6.
19.
4.
22.
2.
14.
6
17.
6
20
4.
23.
2.
15.
6.
18.
5.
21.
3.
24.
2.

FIG. 7.

96 of the transverse processes pointed upward from a few degrees to 55 degrees; forty-four of these on the right and 52 on the left, 78 in males and 18 in females. It has been suggested that variations in the transverse processes might be due to posture and occupation. It is possible that the angle of the transverse processes is due to muscle action. It is interesting to note that in Type III, four spinous processes pointed down slightly, 3 on right and one on left.

Long transverse processes, (Fig. 3)—i. e. those whose shadow overlapped that of the crest, and potentially might impinge on the crest of the ilium,—were rather common; the greater number was in Type II, Table 7.

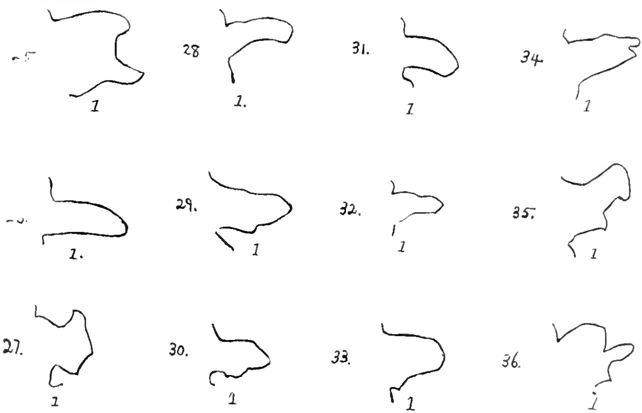


Fig. 8.

Long transverse processes are much more common in men than in women. This would probably be explained by the fact that in men the transverse processes are large and consequently more apt to overlap than in women.

The large fan-shaped or fishtail process (Fig. 10) which overlaps the ilium and frequently is fused with the sacrum is not uncommon. 8½ per cent showed this variation on one or both sides. (Fig. II.) There were seventeen cases of this type,

ten males and seven females. (Table 8.) All but two were of Type II.

Bifurcation of the first sacral (Figs. 12-13) is a fairly common condition. In three hundred examined, there were nineteen cases,—about six per cent. Four were in Type 1,—all males. In Type II there were 9 males and one female, and in Type III, there were five females. The proportion of males to females is about the same as in the total number of cases seen.

FIG. 9.

FIG. 10.

Spondylolisthesis seems to be more common than is usually supposed, and is probably overlooked in a good many cases. In 300 cases there were 19 suggestive of this condition. (Fig. 14) Four were males, Type I, and two females. In Type III, one male and one female. In all, there were 13 males and 6 females. As would be expected, occupation seems to have a definite role in causing this condition. There were four miners, two foundry workers, one laborer, one farmer, one auto repairer.

In no case was there a definite separation of the sacro-iliac joint. In several, the joint seemed wider on one side than on the other, but this was probably due to the position in which the X-ray was taken.

Fig. 11.

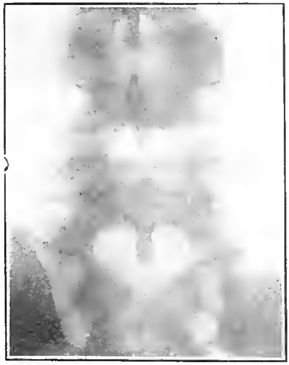


Fig. 12.

Fig. 13.

Fig. 14.

Summary:—The study of these plates seems to show that the sacra and sacro-iliacs may be divided into three types. Type 1 is seen in both males and female.

Type II is distinctly a male type and Type III distinctly female.

In Types I and II, over-lapping transverse processes are common. It is impossible to tell, however, from the X-ray whether this is merely an overlapping of the shadows or whether there is actual contact. It seems probable that where contact takes place, it is more likely to occur in Type II. Type II also seems to show more irregularities in the shape of the transverse processes, and in the structure of the sacrum and shape of the sacro-iliacs.

The measurements, not of great accuracy for comparative use owing to the varying conditions, but constant in each case, seemed to show a very definite and, in many cases, a marked asymmetry.

The size and shape of the transverse processes varied greatly and in the majority of cases were quite asymmetrical, of distinctly different types. Even in those cases where they were alike they showed distinct differences, and in a large number of cases they pointed upward to a greater or less extent.

Large fan-shaped transverse processes are rather common; when single they seemed to occur more frequently on the left side. They are much more common in the second type.

Bifurcation of the first sacral spinous process is fairly frequent, 6% of the cases showing this defect.

Spondylolisthesis of varying degree is probably more common than usually supposed, also rotation and slipping between the lumbar and sacral articulations.

There are also rarer cases that show congenital malformations.

In conclusion, there seems to be no one type that might be called normal. There are many variations in the lumbo-sacral region. Asymmetry is the predominating feature, and, at any rate from the X-ray, it is impossible to say which special combination of types is normal.

Table 1.

Ages	Male	Female	Total
10 to 20	4	7	11
21 to 30	25	26	51
31 to 40	52	25	77
41 to 50	57	26	83
51 to 60	18	7	25
61 and over	7	3	10
Total	163	94	257

Tabel 2.—Occupations

Housewife	40	Carpenter	7
Laborer	27	Cook	6
Miner	24	Blacksmith	5
None	22	Foundry	5
Factory	10	Farmer	5
Teamster	8		

The remainder divided between 54 other types of occupation.

Table 3.—Distribution by Types

TYPE I.

Total number of men	51
Long transverse processes: Right, 5; left, 5; both	10
Total number of women	29
Long transverse processes: Right, 2; left, 3; both	0

TYPE II.

Total number of men	57
Overlapping transverse processes: Right, 13; left, 8; both	18
Total number of women	2
Overlapping transverse processes: Right, 1; left, 0; both	0

TYPE III.

Total number of men	5
Overlapping transverse processes: Right, 0; left, 0; both	0
Total number of women	35
Overlapping transverse processes: Right, 0; left, 0; both	0

Cases with large fan shaped processes are not included in this table.

Table 4.—*Sacral* Measurements

The figures represent the differences in width. When placed in line A they indicate that the upper measurement was greater than the lower, and the reverse when under B, when in line S the measurements were the same. Measurements are in centimeters.

TYPE I.

Case No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	.2	....	1.5	.2	....	.6	....	.1	....	.2	2.0	1.3	.2	....	....
B.	....	1.2	....	....	....	....	.1	....	....	....	....	....	....	1.6	2.0
S.	....	....	....	....	/	....	....	....	/	....	....	....	....	....	....

Case No.	16	17	18	19	20	41	42	43	44	45	46	47	48	49	50
A.	....	....	1.8	1.8	....	....	....	....	....	....	....	....	....	....	.6
B.	.6	2.0	....	....	.4	.5	.5	2.5	2.0	1.5	3.5	1.3	2.0	.8	....

Case No.	70	71	72	73	74	75	76	77	78	79	Average
A.	1.5	.1	.5	2.0	.3	3.0	.2	3.0	1.4	2.1	0.91
B.	....	....	....	....	....	....	....	....	....	....	1.4
S.	....	....	....	....	....	....	....	....	....	....	.2

TYPE II.

Case No.	81	82	83	84	85	86	87	95	89	90	101	102	103	104	105
A.	.6	.3	.6	.5	....	1.5	....	1.0	.5	....	....	1.0	....	....	....
B.	....	....	....	....	.4	....	.3	....	....	....	1.3	....	2.6	1.1	.9
S.	....	....	....	....	....	....	....	....	....	/	....	....	....	....	....

Case No.	106	107	108	109	110	126	127	128	129	120	121	132	133	134
A.	....	....	....	....	....	....	....	....	....	....	....	....	....	....
B.	1.1	2.3	.8	1.5	.9	2.2	2.3	1.1	.3	3.7	1.0	1.2	.9	.8

Case No.	135	122	123	Averages
A.	1.1	....	....	0.78
B.	....	1.3	.3	1.2
S.	....	....	....	1.

TYPE III.

Case No.	138	139	140	142	143	144	145	146	147	148	155	156	157
A.	.1	.8	1.0	1.8	2.2	1.1	.2	1.1	1.3	2.0	1.9	....	3.1
B.	....	....	....	....	....	....	....	....	....	....	....	....	....
S.	....	....	....	....	....	....	....	....	....	....	....	/	....

Case No.	158	159	169	170	171	172	173	174	175	176	177	178	Average
A.	.2	1.9	1.0	2.0	2.3	....	1.0	.3	....	2.3	1.8	.6	1.35
B.	....	....	....	....	....	.3	....	....	....	....	....	....	.3
S.	....	....	....	....	....	....	....	....	/	....	....	....	.2

TABLE 5.—VARIATION IN VERTICAL DISTANCE OF SACRO-ILIACS BY TYPES

TYPE I.

Right longer in........................15 cases. Average 0.38 c. m.
Left longer in........................13 cases. Average 0.34 c. m.
Same in........................10 cases.

TYPE II.

Right longer in........................ 9 cases. Average 0.55 c. m.
Left longer in........................17 cases. Average 0.45 c. m.
Same in........................ 6 cases.

TYPE III.

Right longer in........................11 cases. Average 0.39 c. m.
Left longer in........................ 9 cases. Average 0.47 c. m.
Same in........................ 5 cases.

TABLE VI. A. TYPE I

M. Male - T: Transverse Process Touches   Large Nos. rep. types of Trans. Processes in Fig.
F. Female - L: Transverse Process Laps.   A: Angle of Process Upward
B. Bifid 1st Sacral - S. Shallow Sacroiliac.   D: Angle of Process Down.   } large angles shown in degrees

R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
1 F 1	1 T	11 F 1	1	21 F 2	2	31 M L 10 23°	2 20°	41 M 8 52°	8 37°	51 M .5	A 2.	61 M .3	T. 4.	71 M 2.	11
2 F 5	L 14	12 F 6 5°	10 28°	22 F 8	12	32 M T 5 37°	2'	42 M 10 37°	L. 8 33°	52 M 13	4.	62 M A .3	S. 3.	72 M A 9.	S. 11
3 F 5	S 2.51.	13 F 21	2	23 F 1 22°	14	33 M L 9 18°	B 2 17°	43 M 11	A L 1	53 M 4	9	63 M 8	B 11	73 M A 3	A 3
4 F 10 25°	5 15°	14 F 9	3	24 F 16 L	8 T	34 M 20 15°	L 12 21°	44 M 14	A L 5	54 M 9	A 13	64 M 20	4. –	74 M 11	11
5 F S 1 + L	S 15	15 F 3	2.	25 F 13 37°	6 T	35 M 20 28°	L 5 40°	45 M L 1	A L 3.	55 10 31°	T 8 35°	65 M 15	4. 44°	75 M 13	13
6 F S 2	1	16 F 2	2	26 F 3.	6	36 M 4.	T 4	46 M L 9	L. 4.	56 M 9	18	66 M 8	11	76 M 6	5
7 F 1	3	17 F 18 26°	18 25°	27 F 9 25°	S 10 33°	37 M A 4.	A L 11	47 M L 5	L 5	57 M 11	11	67 M 2.	S 21	77 M 4	4
8 F 1	2	18 1	5.	28 F 11	9 28°	38 M 12	L. 12.	48 M X	X	58 M 9	T. 4.	68 M S 2	S 18	78 F 8	8
9 F X not shown	3	19 F 3.	3.	29 M L 6 36°	5 57° T	39 M 10 24°	L 10 42°	49 M 2	2.	59 M 17	4.	69 M A 5	A 6.	79 M 3	8
10 F 16	21	20 F 9	1	30 M L. 4. 22°	T 8 37°	40 M A. 8	A.L. 8	50 M 10 40°	10 32°	60 M 13.	T. 5.	70 M B 2	A 1	80 M 9	A 3.

TABLE VI. b TYPE II.

R	L	R	L	R	L	R	L	R	L
81 M 4	S 9	93. M A 9	5	105 M L 6 40°	L 3.	117 M L 4.	L 5.	129 M 9	12
82 M 6	3	94 M 9	B S 4.	106. M A L 5	S A. 6	118 M. L. 5.	L. 5.	130 M 6	6
83 M 2	B. 2.	95 M 12	S 2	107 M L 2.	B 4.	119 M. L 5	L 6	131 M L 10	L 10 32°
84 M 14	27.	96 M. L. 6	T .3. 57°	108 M. L 1	B 6	120 M. L. 17	L. 3.	132 M 12	10.
85 M. 19.	A 3.	97 M. L 23.	S 1 57°	109 M L 5	L 10.	121 M. L. 9	A.L 9.	133 M. 6	10 33°
86 M 2	2	98 M. L. 6	T. 5	110 M. SL. 12	S.L 12.	122 M L 1	L 1 25°	134 A 16	4 S 3.
87 M S 16.	S. 22.	99. M. 4 T 1	A L. 1	111 M. AL 8	AL 8	123 M. L 4. 40°	L 4. 40°	135 F 9	S B 4
88 M. S 1	B. T 17.	100 M. L 5	T 6 40°	112 M. L. 1	L 4.	124 M 4 T 1	A T 4	136 F L 7	3 51°
89 M S L. 22.	S. 5	101 M L. 4	S. 5.	113 M. L. 2.	L. 6.	125. M. 2	1 39°	137 F. 19	A 4.
90 M 8	A.T. 8	102 M. A L 2	5	114 M. A L 8.	L 5 55°	126 M. 3	L. 6		
91 M 1	B. 17.	103. A.L 16	10.	115 M. L 12	B L 9.	127 2	L 5		
92 M. 8	4.	104 M. T 2	4.	116. M. L. 5	L. 12.	128 T 4. 41°	L. 5.		

TABLE VI. c.
TYPE III

R.	L.	R.	L.	R	L	R	L	R.	L.
[illegible] M S 4	S B 13.	148 F. S 1	18 S	158 F. 12	12	168. F X	S X	178 F 1	1
139 M. A. 18	A. 18	149 F. 2	X	159 F. 32	24.	169. F. 2	2.	179 F. A 8	A 12.
140 M 28	A 11	150 F S 2	S. 4.	160 F. S. 4.	3.	170. F. 3	S. 11	180 F. S 19.	S. 3
141 M. 17	B 1	151 F 3	6 S.	161 F. S 6	S. 1	171. F. 1	S 11	181. F. S. 34.	S.B 2.
142 M 4	B 16	152 F D S 9	S 4	162 F. D.S. 1	S. 2	172. F 1	1.	149 F. S 6	Type I S A -3
143 M. S 9	S 2	153 F 29.	18	163 F. 6	3	173 F. 26	1		
144 F D 1	D 1	154 F D 1	3	164 F. 32	23	174 F. S 8	S. 8		
145 F. A 4	2.	155. F B 4	S. 15.	165 F. 11	24	175 F. 6	8		
46 F 1	3.	156. F 30	31	166 F. 9	9	176. F. S 10. 41°	S 13. 36°		
147 F. 9	6	57 3 S.	3 S.	[illegible] F. 5.	19.	177. F 6	6		

TABLE VI. d
TYPE–Large fan shaped Transverse Process

R.	L	R	L	R	L	R.	L	R.	L
182 M. T. 10	Type II L 7.	186 M 6	Type II S L 7	190. M. L 7	Type II S L. 7	194. F S.L 7.	Type I. S.L 7	198 F. S L 7	Type I S.L. 7
183. M. 35. -L	Type II L 7.	187. M. S.L 7	Type II. L. 7	191. M. L. 7	Type II. L. 7	195 F. L. 7	Type II L. 7		
184. M. A T 3.	Type II L 7.	188 M. S L 7.	Type II S L 7.	192 F. L 7	Type II S T 36.	196 F L. 7.	Type II. S.L. 7.		
85 M A 9	Type II L. 7.	189. M L 7	Type II S L 12.	193 F L. 7	Type II L. 7	197 F. S L 7.	Type II. C. L 7.		

Table 7.—Overlapping Transverse Processes

TYPE I	Right	Left	Both	Total
Men	4	9	3	16
Women	2	2	....	4
TYPE II				
Men	15	7	14	36
Women	1	0	0	1
TYPE III.				
Men	0	0	0	0
Women	0	0	0	0

Table 8.—Large Fanshaped Transverse Processes

TYPE I.	Right	Left	Double
Men	0	0	0
Women	0	0	2
TYPE II.			
Men	1	5	4
Women	1	0	4
TYPE III.			
Men	0	0	0
Women	0	0	0

SOME ASPECTS OF THE MECHANISM OF THE HUMAN FOOT IN WALKING

BY ALEXANDER GIBSON, M. A., M. B., CH. B., F. R. C. S., (ENG.) F. R. S. E., F. A. C. S., WINNIPEG, MANITOBA

Much has been written about the human foot and its mechanism so that it would almost seem that there remains very little to be said in regard to the subject. Most of what has been said, however, deals with the foot as a static machine, and the fact that the foot is a contrivance especially adapted for locomotion has been obscured. The text books of anatomy speak of the arches of the foot, and the general public, deriving its impressions indirectly from this source, is much interested in the subject of "Fallen Arches."

While an arch is a perfectly suitable architectural arrangement for a building, a bridge, or any structure that remains fixed in the one spot, it is not the correct term to apply to a structure which gives support to a body in motion. It would almost seem self-evident that the analogous structure for a kinetic mechanism is a spring, and yet so far as I am aware, there is no reference in the literature to the springs of the foot. The only approach to the terminology with which I am acquainted is the denomination of the inferior calcaneo-scaphoid ligament as the "spring ligament" of the foot.

Interpretation of the mechanism of the foot by a study of the gait of the ordinary town-dweller is in many respects unsatisfactory. The use of foot gear from our earliest years has interfered with the normal development of the intrinsic musculature, and the comparatively small amount of walking which we are accustomed to do enables us to remain satisfied with feet which are hardly ever developed to their full capacity as organs of locomotion.

It is a truism that structure and function go hand in hand, and it is possible from a study of the anatomy of the foot to obtain a fairly accurate idea of the ideal aimed at in the structure of the foot, if the latter be looked upon as essentially a kinetic mechanism, not a static one. From the purely static standpoint, any club-shaped termination to the lower extremities would serve our purpose as a basis of support; indeed, the more solid and un-

yielding its character the better would it suit us; the foot, however, is not of this nature, it is composed of many segments and is capable of changing its shape so that support is given to the superstructure now in one way, now in another. It is thus essentially a kinetic mechanism, and the term "arches" applied to various parts of it is not so accurate or so significant as the term "springs."

The almost universal use of the automobile has familiarized us with the essentials of a spring. It is an arrangement whereby shocks due to inequalities in the road are minimised. If an ideal spring could be found, such shocks would be entirely eliminated. In practice the spring, as applied in the motor car, is a flexible band or bands of metal, and diminution of the shock is brought about by bending or deformation of the spring. This process of deformation takes a certain amount of time, and thus the transmitted shocks are not so sudden; again as the spring is straightened out the resistance to bending becomes gradually greater, so that the shock is met by a graduated resistance. Without entering deeply into the mechanics of springs, it will I think be evident that the value of a spring must depend on, among other things, the material of which it is made, and its length. The more flexible the material, the greater will be the power of the spring to convert a vertical impulse into a horizontal deformation; the longer it is the greater the amount of such conversion. In other words a "soft-riding" spring is flexible and long. Conversely a "hard-riding" spring is short and rigid.

One other quality is a prime necessity in a spring, viz. strength. Now, the shorter and more rigid a spring the stronger it is, the longer and more flexible it is the more readily does it break when the amount of deformation to which it is subjected is greater than it can recover from. Hence in the small car built for work over all sorts of roads, the springs are short and rigid, while in the large expensive cars, where easy riding is the main desideratum, long flexible springs are the rule. The average car builder endeavours to strike a happy medium, where a moderate amount of flexibility is combined with a considerable amount of strength. In the human foot, no such compromise has been made. Instead of that two springs have been placed side by side. On the outer side of the foot there is a short hard strong spring; on the inner side of the foot there is a long flexible spring. In the act of walking, the weight is transferred from one to the other. Again, as happens in

other machines, the long flexible spring is apt to give way when a deforming stress is applied either too great in amount or for too long a time for the spring to recover completely. This is the reason why the inner border of the foot is the weak part of the foot. It is often said that the reason why foot strain affects the inner margin of the foot is that the normal distribution of the weight of the body falls medial to a vertical line passing through the centre of the inferior surface of the os calcis. No doubt this is correct, and is applicable to the foot in its static state, but it is probably not accurate when applied to the foot in motion.

Although we speak of two springs in the foot it must be clearly understood that no suggestion is made that they are separate the one from the other with independent action. The foot is one organ not two, and the presentation of two functional springs is intended solely to emphasize the characters of the outer and inner margins respectively. Taking part in the material of each spring are bones and joints, ligaments, tendons and muscles. In both cases the point of maximum convexity of the spring is supported by a tendinous sling whose upper attachment is to the bones of the leg. In this tendinous sling, at the point of maximum strain, there is a nodule of cartilage or even a sesamoid bone.

The outer spring is made up of the following bones: os calcis, cuboid, 4th and 5th metatarsals. The joints between these bones are practically vertical. In the case of the calcaneo-cuboid joint the saddle shaped surfaces allow a small amount of gliding movement but they practically interlock. The chief ligaments concerned are the long and short plantar ligaments which extend from the under surface of the os calcis to the bases of the three middle metatarsals, forming on the way a sheath for the peroneus longus tendon. Under the cuboid, embedded in a groove in the bone, is the tendon of the peroneus longus. The abductor minimi digiti and the outer slips of the flexor brevis digitorum act as elastic chords across the arc of the spring.

The inner spring is made up of the os calcis, the scaphoid, the three cuneiforms, especially the second, and the first three metatarsals, especially the first. The part of the spring which sustains most strain is the interval between the os calcis behind, and the scaphoid in front; these bones do not normally articulate and this interval is filled by the extremely strong inferior calcaneo-scaphoid

ligament, this structure being supported in its turn by the tendon of the tibialis posticus which has frequently at this point a sesamoid nodule. The interosseous ligaments passing between scaphoid and cuneiforms and between cuneiforms and metatarsals need no special description. The abductor hallucis and the flexor tendons to the first three digits act as additional elastic supports.

The astragalus is not exactly a part of either spring. It forms the connecting link between the bones of the leg above and those of the foot below. When in walking the heel is placed on the ground the foot assumes the dorsiflexed position. This brings the widest part of the superior surface of the astragalus into the malleolar mortice, and thus adds security. In this position also the lateral anterior inferior angle of the talus engages firmly in the groove lying anterior to the posterior facet on the superior surface of the os calcis, and an articular facet may even be developed on the anterior face of this groove. In this way ample security is obtained in transmitting the weight of the body to the heel. It is noticeable that in descending a hill or in walking over hummocky ground, one instinctively dorsiflexes the foot so as to obviate the risk of sprain.

One should also not lose slight of the fact that anatomically the human foot is a very highly specialised structure, much more so than the human hand. That the foot is the more highly modified organ is easily appreciated if it be remembered that man is the only animal who walks in the erect position, and he is therefore the only animal who has an organ of locomotion specially adapted for the erect attitude. It is perhaps worth while to emphasize the fact that the capacity of the human hand for marvelously delicate work is essentially a cerebral development; there is practically no action of the hand muscles themselves that cannot be performed by the hand of the anthropoid apes. The hand of man is distinguished by the high degree of development of coordinated purposive action. (Wood Jones.) Further, it must be remembered that the human foot is in a state of active evolution. The fibular or post-axial side is tending to undergo evolutionary atrophy, and the tibial or pre-axial side is tending to undergo hypertrophy. Coincident with this, there is a shifting of the longitudinal axis of the foot to the second digit, as is evidenced by the distribution of the interosseous muscles. This fact may account for the variability of articulation between some of the bones of the tarsus, and

may be one source of difficulty for us in interpreting anatomical findings.

Let us now summarise the actual sequence of events in normal walking. The heel is brought first of all to the ground with the foot in dorsiflexion, and from there the weight is transmitted to the outer spring of the foot almost entirely. The weight is thus mainly borne by the short hard spring. Next the weight is gradually transferred across the heads of the metatarsals to the inner side of the foot. A gradual roll of small amplitude accomplishes this. The under surface of the os calcis is curved, and the fibro-fatty tissue between the bone and the skin acts as a yielding cushion. The cuboid bone is wedge-shaped, the small side of the wedge facing outwards, and the result of pressure on the outer spring must be to press this bone inward to a slight extent, thus transmitting some of the shock of impact of foot on ground to every bone of the tarsus and metatarsus. At the completion of the second stage, the foot is balanced momentarily on the tripod consisting of the os calcis posteriorly, the heads of the fifth and first metatarsals anteriorly. From this point onward all the weight is taken on the inner spring. The head of the first metatarsal sustains all the weight of the body in the take-off for the next step. The long flexible inner spring acts for the succeeding step the role of a diving board. The line of transmission of weight is along the first metatarsal shaft to the base, then through the interosseous ligament to the base of the second metatarsal which is recessed between the first and third cuneiforms, then through the second cuneiform to the central part of the scaphoid, and through it to the astragalus and so to the bones of the leg. The middle cuneiform and the central part of the scaphoid are thus the key bones of the inner spring of the foot. The middle cuneiform is buttressed on either side by the first and the third cuneiform bone and the scaphoid is similarly buttressed by the strong inferior calcaneo-scaphoid ligament below, and by the external calcaneo-scaphoid ligament on the outer side.

It may be asked what is the ultimate design of this elaborate mechanism. The reason is probably a phylogenetic one. It is of the utmost importance for the hunter pursuing his prey to preserve as clear a view of it as possible while he is in motion; equally important is it if he be in flight that movement of the head, and especially of the eyes, be reduced to a minimum. For reducing to small

dimensions the vertical movement of the head there is abundant provision in the free movement of hip joints, of knee joints and of ankle joints. The provision of a double spring in the foot itself is, however, the best possible insurance against side to side movement in walking. When the weight is borne almost entirely on the outer side of the foot, there is of necessity a lateral roll in progression of the "nautical" variety. Some observations published by Hendrix support the view that steadiness of the head is one of the essential points of progression.

Civilised man practically always uses heels to his boots in walking. Are these beneficial or harmful? If no heel be used, then it must be obvious that the first phase of the step where the heel is brought to the ground is accomplished with greater security. Dorsiflexion of the foot is more complete, and there is much less tendency to sprain the ankle. During the second phase the presence or absence of a heel makes very little difference to the individual. During the third phase the absence of the heel makes the amount of physical exertion called for excessive; it is necessary to raise the body through a greater distance than if a part of the ascent is already accomplished by the use of a heel to the boot. Again, the presence of a heel throws the line of weight of the body a shade nearer to the head of the first metatarsal which is acting as the fulcrum for the next step. Thus the force necessary to lift the weight of the body is appreciably less. In this way the use of a heel saves energy both in regard to the amount of weight to be moved and the distance through which the weight has to be moved. If heels of excessive height be used, the result is in all respects unsatisfactory. During the first phase of the step there is pronounced insecurity, especially when to excessive height of the heel there is added a very small area, frequently less than one inch square, and even this area of support is set so far forward that it provides no direct prop to the weight of the body. During the second phase when the roll of the foot is taking place and the weight is balanced momentarily on the tripod of the foot formed by the heel, the head of the fifth and the head of the first metatarsal, the high heel is pernicious because it reduces the basal area of the tripod, and substitutes for the broad secure posterior resilient platform which nature provided, a narrow, tottering, unstable perch which a shower of rain may reduce to pulp or an unguarded step may wrench from its attachment.

During the third phase of the step the high heel is equally a disadvantage for it keeps the foot in constant plantar flexion, and throws the body weight too far forward. The calf muscles are not exercised, indeed they cannot contract to advantage, for there is too much slack to be taken up before by their contraction they can do actual work in raising the heel off the ground. Their position in this respect is comparable to that of the forearm flexors when the hand is maintained in palmar flexion at the wrist joint. The maintenance of the foot in constant plantar flexion also keeps the extensor muscles on the front of the leg in a state of persistent over-stretching, and thus they too are weakened. With too high a heel the steps are of necessity short, and stumpy, a springy gait is an impossibility. Again the effort to avoid sprain of the joints of the ankle and the foot necessitates the muscles of the lower limb being kept in a condition of constant watchfulness, so that to the fact that they act at a disadvantage, there is added the fact that more is expected of them than nature designed them to accomplish.

From this consideration the fact emerges that the use of a heel on the boot involves a sacrifice of stability. But since the ground we tread is for the most part smooth, and comparatively free from obstacles, a small sacrifice of this may be made with impunity. If it be admitted that the use of a heel to the boot economises expenditure of energy in locomotion, it will be seen that the use of a heel of moderate height is a measure of practical utility. More important than the height of the heel is its area. This should always be large. For practical purposes a heel not exceeding an inch or at the most an inch and a half in height permits of active use of the calf muscles, does not excessively throw the weight forward, and yet takes off a considerable portion of the muscular strain of walking. One must bear in mind that in walking the minimum of muscular effort is made. If sufficient is called for to produce tiring of the muscles, the result will be that more and more weight will be thrown on the ligaments, the muscles themselves will be used as ligaments, and there will be consequent stretching with development of the symptoms of foot strain. This is well seen in the case of ballet dancers who are said to be for the most part flat footed. They have developed extreme flexibility of the joints of the foot, along with excessive muscular power. When necessary the arch of the foot can be formed in exaggerated degree, but when off guard

as it were, they tend to use the muscles as ligaments, and the foot is correspondingly flat.

As a further corollary, it follows that the boots used should be long enough and wide enough to give free play to the intrinsic muscles of the foot, they should be in no respect splints for the foot, and active development of the foot muscles is likely to provide the best safeguard against the painful condition known as "foot-strain."

RECONSTRUCTIVE SURGERY OF TRAUMATIC FOOT AND ANKLE DEFORMITIES

BY ALBERTUS COTTON, BALTIMORE, M. D.

The title of this paper was chosen because of the number of traumatic deformities of the foot and ankle resulting from the great war that are presenting themselves for treatment at this time.

Before considering methods of treatment of deformities of the foot and ankle, it might be well to review their functions. The functions of the foot in order of their importance are (a) to support the body weight, (b) to give attachment to the muscles of the leg and foot, (c) to act as a lever in progression, (d) to furnish the spring movements in walking by permitting lateral and up-and-down movements. By special arrangement of the tarsal and metatarsal bones in the form of arches supported by ligaments and muscles this spring movement is obtained. The lateral movement takes place through the sub-astragaloid and medio-tarsal joints. The functions of the ankle joint are first to allow forward and backward motions of the foot upon the leg, to act as a hinge joint, and to transmit the body weight to the foot. The astragalus is the mortise bone beween the tibia above and the os calcis below, the internal and external malleolus on either side. The most important function of the foot is to support the body weight transmitted through the ankle joint. If the foot and ankle are in proper position to support the body weight painlessly, the patient will be able to stand and walk without crutch or cane. If the mobile function of the foot and ankle is lost, the patient will lose the full lever action obtained through the movement of the ankle joint and the normal elastic springy gait secured by movement of the tarsal joints. While loss of the mobile function is a great handicap, it does not prevent the patient from getting about, earning a livelihood and leading a fairly active life, providing always that a good weight bearing function is preserved.

What are the essential requisites for a good weight bearing ankle and foot? First the foot must be in proper relation to the leg—to use an automobile expression, the foot must

sition of the foot to the leg permits the body weight to be properly distributed to the heel, arch and ball of the foot and is, in the great majority of cases, the position of choice. There are some exceptions to the rule among which may be mentioned the equinus position to compensate for a short leg or after the correction of paralytic deformities of the foot (Whitman operation). Laterally the foot should be in such relation to the leg that a line drawn from the tubercle of the tibia through the center of astragalus should pass between the second and third toes when the foot is held straight up. To meet these requirements, the astragalus must be in its proper place in the mortise joint and there must not be abduction or adduction of the foot at either the sub-astragaloid or medio-tarsal joints. The longitudinal arch of the foot should be nearly normal, neither flat nor hollow. Lowering of the longitudinal arch alone does not necessarily impair the weight bearing function providing the normal weight bearing line is preserved. The painless flat foot of the negro race is a well known example to substantiate this statement. The hollow foot, however, is a much more serious handicap to weight bearing function and in well marked cases always demands treatment, either supportive or operative. The experiences of the great war have served to call the attention of the profession to the serious disabilities that can be produced by a claw foot when subject to overstrain.

Traumatic deformities of the foot and ankle which interfere with the normal function may be caused by injury or infection of the bones of the leg or ankle joint, bones and joints of the tarsus; injury or infection of the muscles or tendons; injury to nerves supplying motor function to the muscles of the leg and foot.

It would evidently be impossible to consider in detail within the limits of one paper the surgical treatment of the many deformities resulting from injury or infection of the bones and joints, muscles, tendons and nerves of the leg and foot. It is possible, however, to present a brief review of the more common types of deformity with a consideration of some of the broad general principles by which we should be guided in their treatment.

A study of these traumatic deformities shows that while the anatomical structures involved and pathology vary, the resultant deformities can be classified more or less definitely into certain types with which we, as Orthopedic surgeons, ar familiar. Gun-

shot fractures and osteomyeltis of the tibia produce bowing of the legs, anterior or lateral, often associated with varus or valgus deformities of the foot. The principles of treatment of the deformity do not differ from those governing us in the treatment of the rachitic deformities. Gunshot fractures of the ankle joint with infection of bone and joint often result in deformities similar to those produced by unreduced Pott's fracture (traumatic flat foot) with the additional factor of ankylosis of the joint. Fracture and osteomyelitis of the tarsal bones, especially the os calcis, cause a disability similar to that of rigid weak foot. The treatment of these cases is conducted along the same lines used in the treatment of traumatic and static rigid weak foot.

Destruction of the muscles and tendons with resultant scars often cause different forms of talipes. They are treated the same as we would treat acquired talipes from other causes—i. e. correct the deformity by tenotomy, fasciotomy or myotomy of shortened structures with manipulation to be followed later in suitable cases by tendon transplantation. The treatment may at times be supplemented by excision of scars, skin-grafting or plastic operations.

It is not within the scope of this paper to consider the surgical treatment of different types of injuries to nerves. Most foot deformities due to nerve injury which we see now have received surgical treatment to the nerves—rest, splinting, exploration, freeing the nerve from the scar or end-to-end suture. Irremediable injury to motor nerves of the leg and foot which has failed to respond to the various methods of treatment employed in neurological surgery results in permanent paralysis of the muscle group or groups supplied by the affected nerve. The resultant deformity is a form of paralytic talipes, the treatment of which differs very little from that of paralytic talipes produced by infantile paralysis, cerebral palsy or multiple neuritis.

Deformities Following Fracture at the Ankle Joint.

The most common cause of traumatic weak foot is unreduced Pott's fracture. There are several types of this fracture, which if unreduced cause certain types of deformity. The most common variety is fracture of the fibula about three inches above the external malleolus, fracture of the internal malleolus with tearing of the internal lateral ligament and outward displacement of the

astragalus. This type when unreduced gives us the typical traumatic flat foot—abduction of the foot so that the center of the foot is external to the normal weight bearing line, limitation of the motions of the foot and ankle, especially of adduction and plantar flexion. This deformity gives the typical symptoms of rigid weak foot—pain on changing from a resting to an active position, weakness, lameness and stiffness. While the symptoms of these deformities of the foot are practically the same as those of rigid weak foot due to spasm or actual contracture of the peroneal tendons, the treatment must be different. Tenotomy of the peroneal tendons with wrenching and breaking up adhesions on the outer border of the foot will not cure or relieve the symptoms of this condition. It is necessary to restore the alignment of the foot to the leg, to put the foot back in gear with the leg. The astragalus must be pushed inward so that a line from the tubercle of the tibia passing through its center will pass through the space between the second and third toes. This can be brought about either by osteotomy of the tibia and fibula above the old fracture or by re-fracturing the bones at the site of the old fracture. Simple osteotomy of the tibia and fibula above the old fracture is a simple operation and is quite effective in restoring function in the majority of cases. The cosmetic effect is not all that could be desired. Re-fracturing through the site of the old fracture of the internal malleolus of the tibia and fracture of the fibula has several advantages over osteotomy. It is a more direct attack upon the deformity at the seat of the trouble. At the same time that the bones are re-fractured the adhesions about the tibio-fibular joint can be broken up and the astragalus, together with the lower fragment of the fibula, pushed inward to its normal position. After obtaining this reduction it is frequently necessary to nail the internal malleolus of the tibia in place. It is usually not necessary to use any other mechanical aid to reduction except to hold the posterior portion of the foot adducted and at a right angle to the leg while the cast is being applied. The following case illustrates the treatment by this method:

W. C., age 43, referred to the Marine Hospital by the U. S. Employees Compensation Commission.

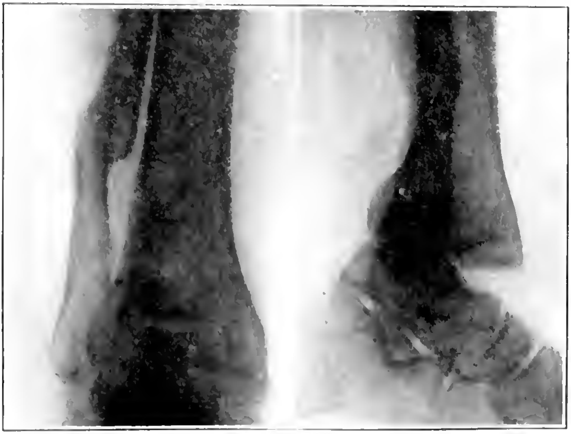
Patient sustained a Pott's fracture November 1916. Fracture unreduced on account of associated burn. Patient admitted to the Marine

Hospital May 27, 1918 suffering from symptoms of traumatic weak foot. Physical examination showed the foot held in abduction and eversion with marked limitation of adduction and plantar flexion; weight bearing line passing to inner ankle and inner side of great toe. X-ray showed unreduced Pott's fracture.

Operation June 1918: Cuneiform osteotomy of the internal malleolus at the site of fracture with linear osteotomy of the fibula fracture; incision through the tibia-fibular joint; astragalus pushed inward to normal position; internal malleolus nailed; tenotomy of tendo-achillis; cast applied. Nail removed August 1918.

Examination Feb. 20, 1920: Patient walked well. The traumatic flat foot symptoms had entirely disappeared and the motions of the foot and ankle were free.

Another rarer type of Pott's fracture is fracture of the fibula, lower third, fracture of the internal malleolus with a longitudinal split of the posterior portion of the tibia extending upward from the articular surface three or four inches with posterior displacement of the astragalus. In this fracture the main portion of the lower end of the tibia is displaced forward,



CASE No. 2—W. S., before operation. Special type of Pott's fracture.

CASE No. 2—W. S., before operation. Special type of Pott's fracture with longitudinal split of tibia and forward projection of lower end of tibia

only a small portion of its lower articular surface, including the longitudinal split, remains in contact with the upper articular surface of the astragalus. There may be also some outward displacement of the astragalus. When this fracture is un-reduced, a characteristic deformity results which differs materially from the deformity caused by the ordinary un-reduced type of Pott's

CASE No. 2. W. S., six months after operation. Operation: tenotomy of tendo achilles, wrenching of foot, osteotomy of tibia and fibula above ankle joint, chiselling away projecting anterior portion of tibia. New ankle joint not disturbed.

CASE No. 2. W. S., six months after operation.

fracture. Many of the symptoms are quite similar but the signs are different. There is limitation of dorsal flexion due to forward projection of the lower end of the tibia and shortening of the tendo achillis. This elongates the heel. The lateral motions of the foot are definitely limited and there may be abduction of the foot. The following is an illustration of this type of deformity:

W. S., age 16. Injury to the left ankle by fall April 1917; patient walked with crutches since time of injury.

First examination made April 1919. Patient had signs and symptoms of traumatic weak foot with pain on weight bearing; foot held in abduction with marked limitation of internal and antero-posterior motions of ankle joint; limitation of lateral motions of foot especially adduction. X-ray showed fracture of the fibula, three and a half inches above external malleolus; longitudinal split of posterior portion of lower end of tibia extending into ankle joint; posterior displacement of astragalus; new joint formed by astragalus below and posterior portion of articular surface of tibia at site of fracture; greater portion of lower articular surface of tibia displaced forward; weight bearing line entirely in front of articular surface of astragalus and to inner side.

Operation April 30, 1919: Tenotomy of tendo-achillis and peroneal tendons with wrenching of the foot; cuneiform osteotomy of the tibia, internal surface and anterior border; linear osteotomy of the fibula at the same level; removal by chisel of the anterior projecting lip of the tibia; correction of the deformity and restoration of the normal alignment of the tibia and fibula anteroposteriorly and laterally; application of cast. The alignment of the fractured bones was checked up and corrected by X-ray examination. Union of tibia in eight weeks; delayed union of the fibula.

Examination Dec. 4, 1919: X-ray examination showed complete bony union of both tibia and fibula; alignment good; both anteroposterior and lateral motions of foot free and painless; considerable motion in ankle joint; patient was able to walk without cane and was well satisfied with the result.

CASE No. 3—D. F., electric wireman, before operation. T-fracture of lower end tibia with varus deformity.

CASE No. 3—D. F., after operation. Note bowing at site of osteotomy.

Another type of deformity due to unreduced fracture of the lower end of the tibia extending into the ankle joint is an acquired talipes equino-varus. The simplest method of treatment of the condition to give the patient a weight bearing foot is by tenotomy of the tendo-achillis and other resisting tendons or fascia and wrenching combined with osteotomy of the tibia and fibula above the ankle joint. This type of deformity is illustrated in the following case:

D. F., age 32, Electric Wireman.

Injury to the right ankle by fall from pole June 6, 1918; sustained a fracture of the lower end of the tibia extending into the ankle joint which was incompletely reduced.

Patient first seen Dec. 3, 1918; using crutches at that time. Physical examination showed thickening of the lower end of the tibia externally and posteriorly; external malleolus more prominent than normal; foot in position of equino-varus; dorsal-flexion limited to 135°; plantar flexion also limited; anteroposterior motions through sub-astragaloid joint; ankle joint

CASE No. 3—D. F., after operation. Operation: tenotomy of tendo-achilles and wrenching of foot; osteotomy of tibia and fibula above ankle joint. Note that upper surface of astragalus is horizontal; lateral alignment normal.

CASE No. 3—D. F., after operation. Note that entire sole of foot rests flat on ground.

ankylosed; abduction and adduction fairly free; patient walked on outer border of foot with heel drawn up. X-ray showed a T-fracture of the lower end of the tibia extending into the ankle joint; astragalus displaced forward and outward; portion of fractured tibia projecting downward in front of ankle joint.

Operation Dec. 10, 1918: Tenotomy of tendo-achillis and wrenching of the foot; linear osteotomy of the tibia and fibula above ankle joint; varus and equinus deformity corrected; foot placed at a right angle to the leg with the foot in normal alignment with the leg laterally. Bowing of the tibia with convexity backward was necessary to correct the equinus deformity. A cast was applied and the position checked up by X-ray the following day. The cast was removed in eight weeks and firm bony union found. Passive motion and massage for one month. The patient went to work April 1, 1919 and has worked continuously since that time at his occupation as electric wireman.

Examination April 1, 1920: Patient states that he has had no trouble but a very little pain in cloudy weather; walks with slight limp; some back knee to compensate for the posterior bowing of the tibia and fibula; foot a right angle to the leg with the sole of the foot flat on weight bearing; slightly more weight bearing to the outer side of the sole; lateral motions

Case No. 3—D. F., electric wireman, before operation. T-fracture lower end tibia with varus deformity.

Case No. 3—D. F., after operation. Note correction of varus deformity.

of the foot through the mediotarsal and subastragaloid joints; ankle joint ankylosed; dorsiflexion possible to right angle only; noticeable bowing of the tibia and fibula above ankle joint with convexity posterior. The patient states that the bowing does not interfere with use and that he can wear a boot. X-ray examination shows callus formation at site of osteotomy with posterior bowing of tibia and fibula; old T-fracture of lower end of tibia; upper surface of astragalus level.

Another common cause of deformity and prolonged disability of the foot is fracture of the os calcis. All Orthopedic surgeons are familiar with the great disability caused by old fracture of the os calcis with associated rigid weak foot. The lateral deformity of the fracture with the shortening of the tissues on the outer side of the ankle and of the peroneal tendons furnishes the pathology for the clinical condition of the rigid weak foot. The prophylactic treatment of this condition is the reduction of the fractured os calcis by manipulation, early use of passive motion and massage and furnishing the proper support to the foot when weight bearing is begun. When these principles of treatment are carried out the disabling deformity so frequently seen caused by the combination of fractured os calcis and rigid weak foot can be minimized. When the condition has developed, the treatment is practically the same as that of rigid weak foot, namely manipulation under anaesthesia with or without tenotomy of the peroneal tendons, over-correction and application of a cast. When there is a definite bony projection on the outer surface of the os calcis which impinges against the tip of the external malleolus on weight bearing or interferes mechanically with the lateral motions through the sub-astragaloid joint, operative removal is indicated. It is to be remembered that the chief cause of the disability is alteration of the normal relation of the leg to the foot together with limitation of lateral movements. If we can overcome these two conditions we can hope to obtain a good functional result in these cases. After removal of the cast proper support to the foot by shoes or plates, massage, manipulation and the baking oven must be used. The following is an illustrative case:

O. R., age 30, sent to the Marine Hospital Nov. 8, 1919, by the U. S. Employes Compensation Commission.

Patient fell 30 feet landing on both heels, causing fracture of both ossa calcis. X-ray examination showed fracture of the posterior portion of the right os calcis with considerable displacement of the posterior fragment;

fracture through the body of the left os calcis with external lateral displacement.

On Nov. 17, 1919 the fracture of the right os calcis was nailed; the left os calcis was moulded into position. Casts were applied to both feet. Three weeks later the casts were removed. Passive motion and the baking oven were used. On Dec. 27th, examination showed the motions good in both feet and ankles. The patient insisted upon walking and left the hospital contrary to the advice of the hospital authorities.

Re-admitted to the hospital March 20, 1920. Examination showed the right foot in good condition. The weight bearing function was excellent and the motions of the foot and ankle normal. The patient had symptoms of a stiff weak foot in the left foot with pain and tenderness under the left external malleolus, considerable bone thickening on the outer side of the os calcis below the external malleolus with marked limitation of the lateral motions especially adduction. X-ray of the right foot showed the heel fracture with the nail in position.

On April 1st the nail was removed from the right os calcis through the old incision. An incision was made over the outer side of the left os calcis

Case No. 4—O. R., before operation. Lateral view of left foot. Note fracture of os calcis with impaction.

Case No. 4—O. R., before operation. Antero-posterior view. Note exostosis on outer surface. Operation consisted of tenotomy of peronei longus and brevus; removal of exostosis with wrenching and correction of deformity.

and the exostosis removed from above and below the peroneal tendons. Tenotomy of the peroneal tendons above the ankle joint was done followed by manipulation. Lateral motion of the foot at the subastragaloid joint was free after removal of the exostosis and tenotomy of the peroneal tendons. The foot was placed in a plaster cast at a right angle to the leg and in moderate adduction. The cast was removed in four weeks. Two weeks later the patient walked without pain with free lateral motion in the subastragaloid joint.

INFECTIONS.

Infectious osteomyelitis of one or both of the bones of the leg or of one or more of the tarsal bones resulting from war injuries has been shown to be a common cause of deformities of the foot and ankle. The principles used in the treatment of osteomyelitis with deformity are first the thorough operative removal of the diseased bone by the cone method with correction of the deformity by osteotomy followed by frequent cleansing of the wound and prevention of pocketing. Dr. Gallie, in his excellent article on the treatment of osteomyelitis, has shown it to be feasible to correct the deformity of long bones by osteotomy through the infected area at the time of operation for the osteomyelitis. If, however, the cases are seen after the osteomyelitis has been treated and the wound healed, the deformity should be corrected when possible by osteotomy above or below the infected area. The following case illustrates this type:

J. E. B., Marine Hospital, War Risk Ins. Case.

Shrapnel wound right tibia July 1918 resulting compound fracture of the tibia followed by osteomyelitis. There were five operations previous to his admission to the Marine Hospital.

Physical examination showed scars of the previous operations, tenderness and signs of inflammation about the middle of the anterior surface of the leg. X-ray examination showed an old fracture of the tibia with anterior and external bowing; loss of bone from the previous operations; area of rarefaction indicating bone abscess and a small sequestrium.

On June 4, 1919 the affected bone area was exposed by a free incision and the diseased bone thoroughly removed with a chisel leaving a cone shaped cavity. The wound was cleansed with pure carbolic and absolute alcohol and packed with iodoform gauze. Ten days later the wound was dressed for the first time. The iodoform gauze was loosened and partly removed, the wound cleansed and re-dressed. The wound was treated thereafter by daily dressings, care being taken to keep the ends of the incision open to prevent pocketing.

On February 22nd examination of the patient showed the operative wound entirely healed. There was some increase in the antero-lateral bowing of the tibia. Arrangements were made to do cuneiform osteotomy of the tibia witb tenotomy of the tendo-achillis. The operation was deferred on account of an injury to the scar by a fall producing an ulcer.

CASE No. 5—J. E. B., before operation. Old fracture with osteomyelitis of the tibia. Note bone cavity inner side; callus outer side.

CASE No. 5—J. E. B., after operation. Note cone shape of operative area; healthy bone; callus formation outer side.

When the function of a muscle or a group of muscles has been lost as the result of trauma or infection and the adherent scar has produced deformity of the foot and ankle, the treatment will depend upon the amount of deformity and disability resulting and upon whether or not there has been associated injury or infection of the bones of the leg, ankle joint or tarsus. The correction of the deformity by tenotomy of the shortened tendons and the fascia and wrenching to be followed later by tendon transplantation is the usual method of treatment when the muscles only are affected. If, however, there is associated bone deformity resulting from fracture, osteomyelitis or ankylosis of the ankle joint, the problem of treatment is quite different. The bone deformity must be corrected as well as the tendon deformity and if there is ankylosis of the ankle joint, the foot must be put in proper position for weight bearing function usually at right

CASE No. 6—C. B., War Risk Insurance, before operation.

CASE No. 6—C. B., War Risk Insurance. Case, before operation. Old fracture lower end tibia extending into ankle joint; osteomyelitis; multiple foreign bodies; destruction of tendons to inner side of ankle; equino varus deformity.

angle to the leg. It may be in such cases that the loss of function of such a muscle group is unimportant and its treatment not essential to restoration of function to the foot and ankle. The following case is an example:

C. B., War Risk Ins. Case, referred from the Marine Hospital.

The patient accidentally received a gunshot wound of the lower end of the left tibia and ankle joint June 1917 resulting in a compound infected fracture of the lower end of the tibia extending into the ankle joint. The end result was destruction of the flexor tendons on the inner side of the

CASE No. 6—C. B., after operation. Note correction of equinus deformity.

CASE No. 6—C. B., after operation. Note correction of varus deformity.

ankle joint with ankylosis of the ankle joint in a club foot position. There was complete loss of use of the flexor longus digitorum, flexor longus hallucis and tibialis posticus. There was also anaesthesia over the distribution of the posterior tibial nerve. Numerous pieces of lead were lodged in the tibia and tissues about the ankle joint. The X-ray at this time showed loss of bone on the inner side of the lower end of the tibia and internal malleolus and bony ankylosis of the ankle joint; equino-varus position of the foot; multiple foreign bodies (lead) in the bone and tissues about the ankle joint.

In Sept. 1918 the deformity was corrected. Tenotomy of the tendo-achillis was first done with wrenching of the foot. Considerable correction of the lateral deformity of the foot was possible after tenotomy and wrenching.

Osteotomy of the tibia and fibula about three inches above the ankle joint was then done. The equinus and varus deformities were easily corrected. The scar on the inner side of the ankle joint was not disturbed. It was necessary to produce a posterior bowing of the tibia and fibula at the site of the osteotomy. Care was taken to see that the varus deformity was completely corrected. After the operation a cast was applied with the foot at right angle with the leg and the lateral deformity corrected. The cast was removed in eight weeks, after which the patient was given passive motion and massage and limited use.

For a while an ankle brace with an outside ankle strap and one quarter inch "Dutchman" outer side sole and heel was used. The patient got about well with a cane.

Examination April 18, 1920: The patient walks without brace or cane. There is no sinus and the scar is in good condition. There is a scant 5° of anteroposterior motion through the subastragaloid and mediotarsal joints.

Case No. 6—C. B., War Risk Insurance. Case, after operation. Operation—tenotomy of tendo-achilles; wrenching of foot; osteotomy of tibia and fibula above ankle joint with correction of equino-varus deformity. Note that upper surface of astragalus is horizontal; lateral alignment normal.

Case No. 6—C. B., War Risk Insurance. Case, after operation. Note lowering at site of osteotomy and correction of equinus deformity.

The ankle joint is ankylosed at an angle of about 105°. This makes the heel about half an inch higher which compensates for the shortening due to the fracture and to bone destruction. The patient wears a shoe half an inch higher than the other with one-quarter inch "dutchman" outer side of sole and heel. There is still slight varus position of the foot and slight equinus. The posterior bowing of the tibia and fibula above the ankle joint at the site of the osteotomy can be seen on inspection of the leg. This causes the patient no inconvenience.

In this case the object of our treatment was to correct the deformity and restore weight bearing function. This was done by tenotomy and wrenching of the foot combined with osteotomy of the tibia and fibula above the old area of infected bone and scar tissue. The treatment of the scar, posterior tibial nerve and inactive flexor muscle group and the foreign bodies in and about the ankle joint was neglected altogether because it was not essential to the restoration of weight bearing function and might have led to serious trouble by starting up the old infecion.

The following is an illustration of the value of osteotomy of the tibia and fibula in restoring the weight bearing function of the foot:

G. S., age 24.

Tuberculosis of the ankle joint and os calcis with ankylosis of the ankle joint. The foot was in a position of equino-varus. The weight bearing was on the outer border of the foot and there was lameness requiring the use of crutches.

Osteotomy of the tibia and fibula above the ankle joint was done with correction of the deformity and application of a cast for eight weeks, followed by passive motion, massage and gradual use of the foot. The deformity was corrected and the patient was able to walk with the sole of the foot flat on a level surface without crutch or cane.

The following case is presented to illustrate the value of osteotomy of the tarsus in correction of old equino-varus deformities—paralytic:

D. B., Soldier, Pa., Private Patient

The patient reported for examination June 1916. The patient gave the usual history of an attack of infantile paralysis at the age of two years followed by deformity of the foot. He had been operated upon twice previously. Physical examination showed very marked atrophy of the muscles of the right leg below the knee and some atrophy of the thigh muscles. The foot was in a position of equino-varus with the head of the astragalus prominent on the outer side of the foot. There was a large callus on the outer side of the foot and an old scar on the inner side. There was marked

cavus deformity of the foot associated with equino-varus. Examination of the muscles showed paralysis of the flexor longus digitorum, flexor longus hallucis and very marked weakness of the extensor longus digitorum and peroneus longus and brevus. The tibialis anticus and posticus and the tendo-achilles and extensor longus pollucis were strong.

Operation June 15, 1916: Cuneiform osteotomy of the tarsus after method of Dr. Cook as reported at the Detroit meeting of the American Orthopedic Association in 1915. A large wedge with the base outward and extending clear through the tarsus was removed. The size of the wedge was calculated from a tracing of the X-ray of the foot. A cast was applied with the foot in the corrected position. Eight weeks later the cast was removed and the patient fitted with a brace.

In a letter received April 12, 1920, the patient states that he is doing his work as a grocery clerk which requires a great deal of standing and walking and heavy lifting. The foot does not give him any trouble. He wore the brace for nine months after the operation but since that time has discarded the brace.

CASE No. 8—D. B., before operation. Paralytic equino-varus deformity.

In the treatment of traumatic deformities of the foot our object should be to restore as good function as possible. When the object can be obtained by simple surgical procedures they should take precedence over elaborate and difficult operations. We should always bear in mind that the weight bearing function

of the foot is most important and our first object in the treatment should be restoration of this function. Having obtained our object, whether or not it is advisable to attempt restoration of other functions is a problem to be decided in each individual case. Unnecessary risks should not be undertaken and fanciful operations should be tabooed. In the first class we would place elective operations through old infected scars, bones and joints and in the second we would place arthroplasty of the ankle joint. In arrested hip joint tuberculosis in the flexed and adducted position with ankylosis most conservative orthopedic surgeons prefer to correct the deformity by subtrochanteric osteotomy and give a

CASE No. 8—D. B., after operation. Operation—Cuneiform section entirely through the tarsus; base of wedge on outer side of foot.

good weight bearing painless hip rather than by arthroplasty with the attendant danger of recurrence of the tuberculosis in the joint, tubercular meningitis or a painful joint with limited motion. Likewise in ankylosis of the ankle joint with deformity from infected joint fractures or osteomyelitis, correction of the deformity when possible by osteotomy of the tibia and fibula above the diseased area is certainly preferable to an arthroplastic operation which in addition to the danger of starting up a latent infection so rarely accomplishes the desired result. Where a cure cannot be accomplished by osteotomy a formal resection with the

object of obtaining ankylosis in a corrected position should be considered.

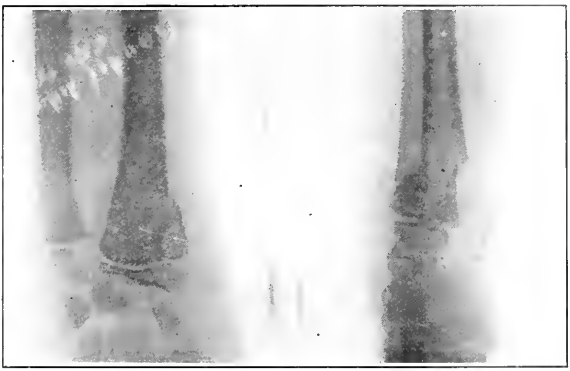
Of the several operative procedures to correct deformities of the foot and ankle, osteotomy is found most useful and often essential. It is used in the tarsus, either linear or cuneiform, especially to correct bad varus deformities. The greatest field of usefulness of the operation is osteotomy of the tibia and fibula above the ankle joint in ankylosis of the joint with deformity. By this operation combined with tenotomy of the shortened tendons, many deformities of the foot and ankle can be corrected and the foot placed in proper relation for restoration of the weight bearing function. In order to bring the foot to a right angle with the leg and the sole of the foot flat to a level surface it is often necessary to produce an antero-posterior bowing at the site of the osteotomy. Lateral deviation must be avoided. If the deviation from the normal anteroposterior alignment is not too great, the deformity in the shaft of the tibia and fibula will be taken care of by the application of Wolff's law—"Changes in form and function will be followed by certain definite changes in the internal architecture and other secondary alterations of their external conformation in accordance with mathematical laws." The new static condition brought about by putting the foot at a right angle with the leg and the sole of the foot parallel to a level surface will cause a gradual transformation in the bone—in the internal architecture and external contour—that in time will largely correct the deformity at the site of the osteotomy. If we, as Orthopedic surgeons, will keep constantly before us the fact that "the pathogenesis of deformity is functional" we will be better satisfied with our more or less imperfect attempts to correct deformities of the ankle and foot providing always that we correct or improve the weight bearing function. In deformities associated with ankylosis of the ankle joint we will resort less frequently to resection, astragalectomy and attempts at arthroplasty and be content to restore the weight bearing function by the simple operation of osteotomy. In none of the cases cited in this paper were the results ideal; in all, however, except two recent cases, there was sufficient restoration of function to enable the patient to walk without the aid of a cane, to get about actively and to earn a living. In conclusion I wish to emphasize the fact that each of these deformities is a separate and distinct

problem to be worked out individually. We should work out our treatment as we would solve a mathematical problem. First obtain the data, which should be a definite knowledge of the structure involved whether of the bones, muscles, joints or nerves; of the pathology whether infection or trauma or both; of the variety of deformity whether a form of talipes, deformed tibia, ankylosis of the ankle joint or a combination of several deformities. Having obtained our data, we should consider it most carefully and then apply our knowledge of the science and art of correction of deformities to the treatment of the patient. We should always bear in mind that the object of our treatment is to correct deformity and to restore function as far as possible and to accomplish this end by the simplest methods possible.

FRACTURE OF THE FOREARM IN CHILDREN*

BY JACOB GROSSMAN, M. D.

Complete fracture at the lower end of the radius is of rare occurrence in children. Flexion or greenstick fractures of one or both bones of the forearm is the type commonly found. Classical Colles' fracture, commonly encountered in adults, is very rare in children. In our series of two hundred cases there was only one case which presented both clinically and in the X ray findings, the typical picture of Colles' fracture. (Figures 1 and 2). We did however, observe a number of subperiosteal fractures occurring at



FIGURES 1 and 2. The only case in our series of classical Colles' fracture in children.

the lower end of the radius. These cases presented themselves with a history of having fallen, striking upon the outstretched hand. Examination usually revealed slight swelling, disability and marked localized "pencil" tenderness. Ecchymosis, when present, was very slight. Crepitus, false mobility and deformity were never present. (Figure 3).

Another lesion which we found occurring at the lower end of the radius was a separation of the epiphysis. Epiphyseal separa-

*Based on the study of two hundred cases from the Orthopedic Clinic of Lebanon Hospital.

tion of the radius has always been reported as of rare occurrence. Pfaundler and Schlossmann have reported seeing two cases in a series of one thousand fractures. In our series there were thirteen cases or about six and one-half per cent of the two hundred cases. No doubt epiphyseal separation is a fairly common condition. They are readily overlooked especially when the separation is very slight and the symptoms very mild. In these instances they are usually treated as sprains or contusions. Careful X ray study

FIG. 3. CASE 3. Lateral View. Blanche G. 3 years of age. Diagnosis: Subperiosteal fracture of the radius.

will assist one in reaching a diagnosis. The separation may vary from a slight degree to a well marked one. Where there is a slight separation the symptoms are very mild. Chief amongst the symptoms are pain, localized tenderness and in very severe cases, deformity, crepitus and false mobility. The deformity was so marked in one of our cases, that it resembled the "silver fork" deformity

commonly seen in Colles' fracture in the adult. (Figures 4 and 5). The crepitus as a rule is soft and does not resemble that usually found in fractures. Three of the cases were complicated by infraction of the ulna. The symptoms resulting from the infraction were very mild.

The vast majority of the cases had sustained greenstick fractures of one or both bones of the forearm. The X ray findings in these cases were very much alike. Complete fractures of the bones were rarely present.

FIGS. 4 and 5. CASE 4 Edith S. 8 years of age. Epiphyseal separation of the lower end of the radius.

ETIOLOGY

Of the two hundred cases, one hundred and forty-four were in males and fifty-six in females. The ages varied from thirteen months to thirteen years. There were forty-two below five years of age, ninety-five between six and ten years of age and sixty-three between eleven and thirteen. Of those below five years of age there were twenty-one of both bones, twenty-one of one bone, of which eighteen were of the radius and three of the ulna. Of those between six and ten years of age, there were fifty-two of both bones, forty-three of one bone of which thirty-eight were of the radius

and five of the ulna. Of those between eleven and thirteen years of age, there were twenty-one of both bones, forty-two of one bone of which forty were of the radius and two of the ulna.

The ages at which fractures occurred more commonly, as shown by this series, are between six and ten years, ninety-five or forty-seven and a half per cent of the cases having occurred during this period. The next most frequent occurrence was between eleven and thirteen, sixty-three or almost thirty-one and a half per cent, having occurred at those ages. Below five years of age, forty-two or twenty per cent occurred.

Between six and ten years of age both bones were more frequently fractured, fifty-two or fifty-four per cent of the cases occurring at that period, had sustained fractures of both bones. Forty-three or forty-five per cent had sustained fractures of one bone. Between eleven and thirteen years of age, one bone was more frequently fractured, forty-two or sixty-six per cent of all occurring at these ages being of one bone. Twenty-one or thirty-three and a third per cent were of both bones. Below five years of age there were twenty-one of one bone and twenty-one of both bones.

In the entire series one bone was more frequently fractured, there being one hundred and six or fifty-three per cent. Ninety-four or forty-seven per cent had sustained fractures of both bones.

In the majority of instances the fracture was the result of a fall, the patient striking either upon the outstretched hand or upon the forearm. In a number of instances there was a history of the forearm having been struck a blow, as in one case, where a swinging door striking the forearm, fractured both bones. A slight knock or a mild trauma produced fractures in a number of instances. History of former fractures was elicited in five of the cases. There were no constitutional disturbances or pathological lesions present in these cases to account for the recurrence of the fractures.

Symptomatology

Subjective: These patients were presented with a history of having sustained an injury. In a few instances, especially in the younger children and infants, the parents were not certain that an injury had occurred. Pain and restriction of function were constant symptoms. The pain was especially evident when an attempt

to manipulate the forearm was made. The disability manifested itself in what appeared to be a paralysis of the upper extremity, the latter hanging limply at the side. This was especially so in infants and the younger children. Any active movement was very painful.

Objective: Swelling, ecchymosis and deformity were present in a large number of instances. The swelling and ecchymosis were usually localized to the region of the fracture. The deformity present was angular in character, the angle being directed anteriorly as a rule. In those who had sustained a subperiosteal fracture, deformity was absent. It is this type of fracture which is commonly overlooked. The absence of crepitus, false mobility and deformity often mislead one and a diagnosis of sprain or contusion is made. Ecchymosis is not common, and when present, manifests itself as a slight discoloration. There is usually slight swelling. The characteristic objective symptom upon which a diagnosis can always be made in subperiosteal fracture is "pencil" tenderness. This tenderness is localized to the site of the fracture. It is present in all cases and persists for many weeks after the fracture had been sustained. Very little callus formation occurs during the healing of this type of fracture. This is probably due to the fracture being subperiosteal.

Fractures of the shafts of the bone were mainly of the torsion, greenstick or bending variety. False mobility was present in a large number of instances. Crepitus was elicited in a few. Tenderness was present in all the cases. It was of the "wincing" type, commonly present in bone injuries. It was usually localized to the site of the fracture.

Treatment

The management of fractures in children differs considerably from that in adults. The greater intensity of the healing processes in the former requires a shorter period of immobilization. The tender skin of the infant and child, the movable cover of fat which envelops the bones, makes an exact therapy very difficult. In our experience we have found plaster of Paris bandages more efficient than splints. The affected parts can be controlled readily and accurately without the danger of pressure blebs and ulcers, the result of applying splints too tightly. We have had many cases re-

ferred to us, in which several hours after the application of splints, blebs and ulcers had appeared. Figures 6 and 7).

Another disadvantage of splints, especially in very active children, is that there is a tendency for them to fall off or become displaced. A properly applied plaster bandage will obviate these disagreeable mishaps.

Where there is a fracture of the shafts of both bones, or of the shaft of the ulna or radius alone, the deformity, should one be present, is reduced. Plaster of Paris bandages are then applied, extending from the middle of the arm to the metacarpo-phalangeal

Fig. 6. Blebs, the result of tight splints.

Fig. 7. Volkmann's contracture, the result of tight splints.

joints, leaving the fingers unconfined. The elbow is held at a right angle and the forearm midway between pronation and supination. The patient should be encouraged to exercise the fingers actively from the very first.

The plaster of Paris bandages are retained for about ten days at the termination of which time they are divided laterally, so that they can be utilized later. The limb is then removed and after being baked, passive movements of the fingers, wrist and elbow are carefully given. The limb is then replaced in the anterior posterior plaster bandages. The following day and daily thereafter the treatment as described previously is carried out. After one week of this baking and passive movements, active movements are gradually added and finally exercises. This routine is followed until the movements of the fingers, wrist and elbow are normal and

free from pain. This is usually about three to four weeks after the fracture had been sustained.

One must always bear in mind that ununited fractures of the radius are not uncommon, undoubtedly the result of improper fixation of the elbow joint, pronation and supination being insufficiently guarded against. Also that there is a tendency for the four fractured surfaces to be drawn towards one another and for union to occur with complete loss of supination and pronation. This can be avoided by fixing the forearm so that supination and pronation are impossible. Fusion of the fractured ends can be avoided by preventing all lateral pressure on the bones after proper coaptation. To be successful one must obtain proper reduction and proper immobilization. A pad between the shafts as recommended by many, is unnecessary as it could not separate the bone ends without exerting injurious pressure upon the circulation.

When the fractures occur at the lower third of the bone or bones, the plaster of Paris bandages are applied, extending from the elbow to the metacarpophalangeal joints, that is, to the knuckles behind and the transverse crease of the palm in front. The fingers should be left unconfined and the patients encouraged to move them. The forearm should be supported in a sling. The after care is the same as previously described for fractures of the upper part of the shaft.

Case Reports

Case 1. Blanch M. seven years of age. One week before visiting the Orthopedic Clinic of Lebanon Hospital, the patient fell striking her left forearm on the pavement. As the subjective symptoms were very mild, a physician was not immediately consulted. Came to our clinic with her mother because the slight pain which she experienced still persisted. There was no disability. Chief complaint was pain referred to the upper part of the forearm.

Examination: There were slight swelling over the upper part of the forearm and very little ecchymosis in the same region. The movements of the elbow were normal. There was decided restriction of supination and pronation of the forearm. Tenderness was excruciating and localized to the junction of the middle and upper thirds of the radius. On palpation slight angulation of the deformity was perceptible, even though the deformity was not visible.

A diagnosis of fracture of the radius was made, much to the surprise of the mother, who could not understand how the bone could be broken when her child could use the forearm so freely. Proper treatment was instituted, after reduction of the deformity. The patient made an uneventful recovery, with normal supination and pronation of the forearm. (Figures 8 and 9 are X ray pictures of this case.)

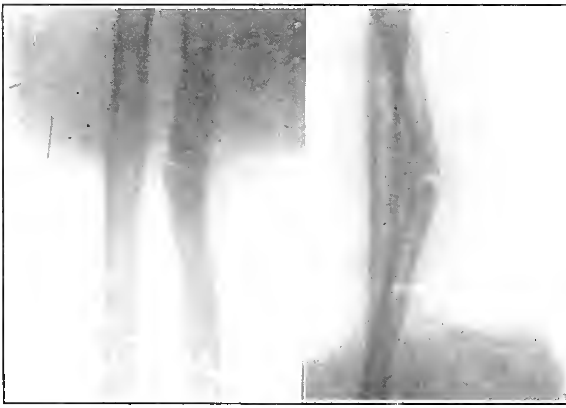


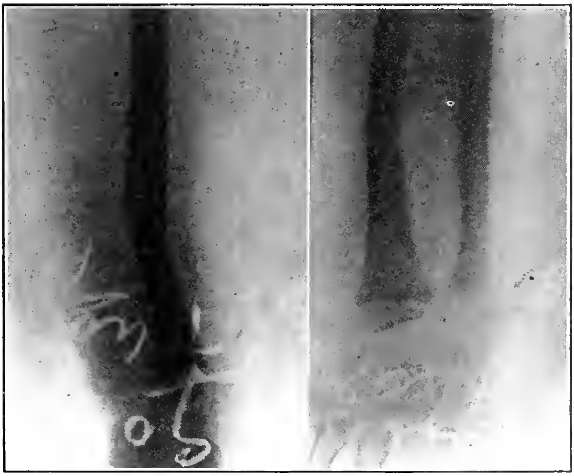
FIG. 8 and 9. CASE 1. Blanche M.—Fracture of the radius.

CASE 2. Ruth F. three years of age. A few days before being referred to our clinic, the patient fell striking upon her right forearm. Immediately thereafter she had terrific pain and was unable to move the forearm. Chief complaints: pain and disability.

Examination: There was swelling which was localized to the affected region. Ecchymosis was absent. There was a slight angular deformity present. Movements of the wrist were slightly restricted. Pronation and supination of the forearm were markedly restricted and very painful. The deformity was palpable. Tenderness was excruciating and most marked about two inches above the wrist joint. Crepitus and false mobility were not ascertainable.

A diagnosis of fracture of both the radius and ulna was made and subsequent X-ray picture confirmed the diagnosis. (Figures 10 and 11.) These X ray pictures again emphasize the importance of taking more than one view of fractured bones. The antero-posterior view shows the fracture but not the deformity. The lateral view shows a well marked angulation of the fracture.

Proper treatment was instituted and the patient made an uneventful recovery.



FIGS. 10 and 11. Ruth F. Fracture of both bones of the forearm.

CASE 3. Blanche G. three years of age fell several days before coming to the Orthopedic Clinic of Lebanon Hospital. She had sustained an injury to her right forearm. The chief complaints were disability and slight pain.

Examination: There was slight swelling over the dorsum of the wrist. Ecchymosis, deformity, false mobility and crepitus were not present. There was slight restriction of the movements of the wrist. Supination and pronation of the forearm were not restricted. There was however, slight pain with extreme passive

supination and pronation. Tenderness was excruciating. It was localized to the lower end of the radius about one inch above the wrist joint. Upon this objective symptom, a diagnosis of subperiosteal fracture of the lower end of the radius was made and a subsequent X ray picture confirmed the diagnosis. (Figure 3.)

The patient made an uneventful recovery.

CASE 4. Edith S. eight years of age. A few days prior to her visit to the clinic, the patient fell from a swing and injured her right forearm. The chief complaints were pain and disability.

Examination: Swelling localized to the dorsum of the right wrist was present. There was no ecchymosis. A well marked deformity resembling the "silver fork" deformity commonly seen in Colles' fracture, was present. The hand was displaced upwards, backwards and outwards. Tenderness was present and localized to the lower end of the radius about one-half inch above the wrist joint. False mobility was present. Crepitus was also present. There also was tenderness over the styloid process of the ulna. The movements at the wrist were all restricted and passive motion produced severe pain. Pronation and supination were also restricted.

A diagnosis of fracture of the lower end of the radius and ulna was made. Subsequent X ray pictures revealed a separation of the epiphysis of the radius and a fracture of the lower end of the ulna. (Figures 4 and 5.)

The patient made an uneventful recovery.

Before concluding the writer would like to emphasize the importance of considering a fairly common lesion, when making a diagnosis of injuries of the forearm in children. This condition is called "traumatic palsy" of the forearm and is one in which a subluxation of the head of the radius occurs. Many of these patients are brought to the clinic with their forearm in splints or their wrists bandaged.

The history of how the injury was received is characteristic. The patient is either dragged along by the wrists or is raised up by the wrists. Immediately thereafter there is complete disability of one upper extremity. The limb hangs limply at the side and resembles a flaccid paralysis. Hence the name. Manipulation of the affected limb results in severe pain. The cardinal signs of fracture are lacking. The diagnosis is made by obtaining a click-

ing sound when the forearm is passively supinated. Immediately thereafter there is resumption of normal movement of the forearm. X ray pictures of this condition are negative. This is because they are X rayed after the reduction of the partial dislocation of the head of the radius. This conditon is mentioned here because many of them are treated for sprains of the wrist or fractures of the forearm.

Summary and Conclusions

1. Where, for any length of time, infants and children refuse to use their forearms, after having sustained an injury, fracture should be suspected.

2. Colles' fracture occurs rarely in infants and children.

3. Fracture may be present, even though the cardinal signs of fracture are lacking. These fractures are usually of the subperiosteal variety. "Pencil" tenderness is the diagnostic sign.

4. Epiphyseal separation of the lower end of the radius should be looked for in all cases with injured forearm. It occurs often enough to be considered.

5. Plaster of Paris bandages are by far more efficient than splints and should be given the preference in the treatment of fractures.

6. Proper immobilization is as important as proper reduction in obtaining a successful issue in the treatment of fractures.

7. Shorter periods of immobilization, early massage and passive movements should be employed in children.

8. A pad between the shafts of the fractured bones, as recommended by many, for the purpose of preventing fusion of the fractures, is unnecessary as it could not separate the bone ends without exerting injurious pressure upon the circulation.

THE NON-OPERATIVE TREATMENT OF SCOLIOSIS

BY WALTER TRUSLOW, M. D.   BROOKLYN, N. Y.

In approaching what is perhaps the most difficult problem in Orthopedic practice, one would wish to be clear in defining the subject. This paper will deal with true rotary lateral curvature of the spine—that is, with the well-known deformity, with structural changes. Functional scoliosis must be dealt with carefully and thoroughly, but is not the bete noir that structural scoliosis is.

It is necessary also to understand just what one may expect to accomplish, and not to pre-suppose what at present seems impossible. Successful treatment of rotary lateral curvature of the spine contemplates (1) stopping the deforming process, (2) materially lessening existing deformity, and (3) reasonably assuring the non-return of the deformity. The present writer agrees with the findings of the recent Scoliosis Committee of the American Orthopedic Association, which stated that no known method had yet been found to restore to body symmetry a structural scoliosis; but he believes that the ends just outlined are worth striving for and are attainable.

Every case must be considered individually; but, in general, the non-operative treatment of structural scoliosis consists in a careful weighing of the indications for and the proper use of (1) corrective plaster-of-Paris jackets, with pressure paddings and negative window spacing, and (2) of specific intensive exercises, with retention brace or corset—often an alternating use of these means. We usually state our procedure in treating deformities, thus: "Correct the deformity first, then insure its non-recurrence." Practically, in the deformity under discussion, we find no means completely to correct the deformity, and I think that most of us agree that there is a very definite limit to the forces which we can exert on the individual patient. So it has long appeared to the writer that the one who assumes professional charge of these patients should outline a procedure which should allow the use of both means, and that he should demand for himself reasonable freedom of decision as to when either should be used. Practically, in the writer's hands an alternation of the plaster corrective jackets and of the retention-muscle training has often been most effective.

But it is insisted that the judgment of the one in charge must be formed and controlled, not only by his observation of the patient's varying general condition, but particularly by a system of measuring of the specific elements of deformity which should be reasonably accurate and yet so easily applied as to be used at each change of plaster-of-Paris jacket and at monthly intervals while the intensive exercises are being taken.

FIG. 1—The type, right-dorsal left lumbar, showing deviation of spine, low left shoulder, upper trunk-lean to the right, and bulge of right-rear chest and of left low torso.

FIG. 2—Adhesive strip placed on spine, record of deviation and of carriage of shoulders marked and relation of upper trunk-lean to plumb line shown.

(Note: In the pictures of the model, the spinous processes have been marked to show the effect of the exercises.)

After first hunting for and eliminating, if possible, unequal lengths of legs and congenital bone asymmetries, the writer finds the following elements of deformity necessary to record at regular intervals:

1. Deviation of the spine, standing.
2. Relative carriage of shoulders, standing.
3. Relation of lateral upper trunk lean to a spinal perpendicular, standing.
4. Deviation of spine, in prone lying.
5. Rotation of spine, in prone lying.

They can be recorded in from five to ten minutes, and the succeeding records, rightly studied, are exceedingly valuable. The patient stands with back exposed from neck to buttocks' fold. (Fig. 1.) A strip of adhesive plaster is placed over the spinous processes, from seventh cervical to first sacral (at top of buttocks' fold); the successive spinous processes are palpated and marked on the adhesive plaster; the level of right and left scapular

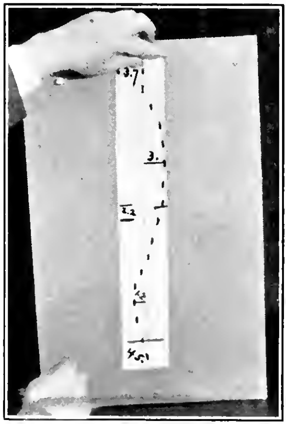


FIG. 3—Transferred adhesive strip, marking the spinous processes, the spinal height, the shoulder levels and the lateral projection of sacral perpendicular opposite seventh cervical vertebra and showing the measurements.

angles are projected and marked on the margins of the adhesive plaster. A plumb line, representing the "sacral perpendicular," is then hung in such a manner that its weight will be opposite the buttocks' fold and the upper end to right or left of the seventh cervical marking. (Fig. 2.) Where the string is opposite the seventh cervical point, a mark is made on the adhesive plaster. To make a permanent record of this, the adhesive plaster is transferred from the patient's back to any flat surface, and the following lines drawn and distances measured. (Fig. 3.) A line is drawn, with ruler

guide, from seventh cervical to first-sacral dot. It is called "spinal height." A line is drawn from it to the dot, representing greatest dorsal deviation; another to greatest lumbar deviation. Either marking, for scapular angle, is projected across the adhesive strip, to get its level relative to that of the opposite scapular angle. Measurements are taken as follows:

a. of dorsal deviation.

b. of lumbar deviation.

c. of spinal height.

d. of relative scapular levels.

e. of projection, to right or left, of seventh cervical vertebra to sacral perpendicular.

A history sheet record of the above reads, for example:

Spine, standing;

Spinal deviation $\dfrac{3.2 + 1.5 -}{45} = .1044$ or $10\frac{1}{2}\%$

Carries left shoulder 3.3 lower.

Carries 7th cervical 1.6 to the right.

The above is a record of certain elements of deformity in standing or weight-bearing posture.

To obtain a record of bony changes, weight-bearing must be eliminated. The patient is placed in a standard position prone upon a table. Another strip of adhesive plaster is used upon the exposed back from seventh cervical to buttocks' fold. Successive spinous processes, from seventh cervical to first sacral, are palpated and marked. Rotations in degree are obtained by the use of the writer's rotatometer. (Fig. 4.) This consists of two hinged arms, with a recording sector fixed to one, and an indicator fixed to the other. The arm with the fixed sector is placed across the back, at the position of greatest dorsal rotation. It takes such tilt to the horizontal as this back transverse may give it. The arm with the index has also a spirit level. This arm is moved up and down until it is levelled, and the degrees of rotation are read as at the place which its index takes on the sector of the other arm. The greatest lumbar rotation (sector arm tilted in

the opposite direction) is taken in the same way. The adhesive strip is transferred, and is ruled and measured for spinal height and for dorsal and lumbar deviations, as when taking these measurements with the patient in the standing position. The history sheet record of these measurements would read, for example:

Spine, prone;

Spinal deviation $\dfrac{2.2 + 1.1 -}{45} = .0733$ (or $7\frac{1}{3}\%$)

Rotations, 8 degrees and 5 degrees.

Fig. 4—Writer's rotatometer. Note arm to parallel the back transverse, the leveling arm and the sector and pointer.

Comparison of the relative measurements of the standing and of the prone positions, of the amount of self-correction possible and of the examiner's correction is an aid to prognosis, but is particularly important in determining how effective is the treatment, and what feature of deformity correction must be emphasized in continuing treatment.

Details of the plaster-of-Paris corrective jacket will not be dealt with at this time. Effective methods of procedure are well known. Each surgeon must use that which he knows best. But some features of technique seem worth emphasizing. First, one must have a very clear idea of the elements of deformity to be corrected. The writer finds it more effective to depend upon the application of the jacket to correct the faulty upper trunk-lean and the low shoulder, and upon the exact placing of subsequent pad-

FIG. 5—The starting position. I. Kneeling.

dings to correct the spinal deviations and the rotations; rather than to emphasize the correction of all deformity elements by the position of the patient upon which the jacket is built. To this end the hips-flexed prone lying position upon the hammock in the frame is chosen. Before plaster dressings are applied, the pelvis is fixed and then the upper trunk is stretched longitudinally and in such a manner laterally as to carry faulty upper trunk-lean across to the opposite side and to lift the low shoulder. This, of course, lessens spinal deviation and, to a slight extent, rotation; but the emphasis is placed upon the faulty upper trunk-lean and the low shoulder. Having in consideration proper counter pres-

sures, when paddings shall be used, care is taken that the transverse of the shoulders shall be in the same plane as the transverse of the pelvis. This and succeeding plaster jackets are distinctly corrective, but pressure forces are to be made quite within the limit of comfort.

Negative window spaces are cut out and first paddings to correct spinal deviation and rotation are applied in two weeks. Succeeding paddings are applied once a week to six weeks from the application of the plaster jacket. During that period the plaster rigidity itself prevents any further correction in the faulty upper trunk-lean and in the low shoulder; but much correction of the spinal deviations, of the rotation and of the anterior rib de-

Fig. 6—Exercise I. 1. To lessen spinal deviation, hollow-back, winged right shoulder and rotation, and to over correct low left shoulder and lateral trunk-lean.

formities may be obtained. The writer emphasizes this point, as he believes that hazy understanding of it accounts for indifferent success.

The appointment for the application of the second corrective jacket must allow sufficient time to take the measurements, to apply the plaster body mould (a rear half is sufficient), from which a cast is to be made for the retention brace or corset, and then to apply the second corrective jacket. The patient's position for the plaster mould for the brace cast is also hips-bend prone and with over-correction of the faulty upper trunk-lean and with levelled

shoulders. The position for the second corrective jacket is hips-bend prone with marked over-correction of the faulty upper trunk-lean and with over-correction of the low shoulder. Its program of four to six weeks is similar to that of the first corrective jacket. It has been applied in greater length, to meet natural growth plus spinal lengthening due to lessening of spinal deviation and spinal rotation. During the wearing of it, further correction of deviation and of rotation and front chest moulding will have been accomplished.

At the end of three months, the figures representing spinal deviation should have been reduced about one-half and that representing spinal height should have been slightly increased. This

FIG. 7—The starting position, II. On hands and knees.

should reduce the ratio of deviation deformity about one-half, or, for example, a ten per cent deviation deformity should be about five per cent. The upper trunk-lean, as indicated by the relation of seventh cervical vertebra to sacral perpendicular, should have been carried nearly to, or, perhaps, passing across the vertical line; and the shoulders should have been levelled. In this time it is usually possible to reduce the figures indicating rotations also about one-half. Although the correcting forces have been but gradually yet steadily applied, and although the cooler months of the year have been chosen and the "scratcher" faithfully used daily, the patient's skin and the patient's disposition will not tolerate more than three months of these jackets.

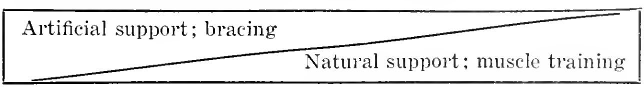
What is now to be done? We know that much of the deformity will recur if we do not hold what we have attained and so train the muscles by intensive exercises that they will increasingly be able to assume the task of natural support, with ever lessening artificial support. The brace or corset, planned for at the time of changing the plaster corrective jackets, should now be ready.

A truly retaining brace is difficult to attain, but is important. The requisites are (1) ability to hold correction attained; (2) "fool-proof"—the patient must be able to apply it with reasonable accuracy; (3) extensibility to meet normal growth, and longi-

Fig. 8—Exercise II, 1. To lessen spinal deviation and to over correct lateral trunk-lean and low shoulder. Not much effect on rotation.

tudinal extensibility and lateral compressibility to follow further deformity improvement which proper exercises will surely give; and (4) finally, if possible, self-correction. (The writer believes that this last will be possible by the use of a laterally bending upper segment of the brace and a stop-joint to prevent bending in the directions of deformity increase. The mechanical difficulties, however, are such as to make a presentation at this time of what has been accomplished premature). The Knight spinal brace can be modified to meet all of the requisites outlined, except self-correction. The brace must be worn by night as well as by day at first.

With the removal of corrective jackets and with the assumption of the retention brace, the intensive exercises begin. The brace is removed for the exercises only. The patient's back is exposed for all exercises, to observe every detail of movement. The starting positions are in kneeling, on hands and knees, in prone lying, on the back, half prone at end of table and finally sitting, to insure as little erect weight-bearing as possible and because from these positions best concentration on the parts to be exercised is obtainable. The muscles must gradually be trained to assume the responsibility of weight-bearing. As the muscles get stronger and bring the superimposed body segments nearer and nearer to the line of gravity of the body, the artificial support of the brace is less and less used. A simple reinforced corset becomes possible. The relation of artificial support to natural support may be expressed by the schematic diagram:



The exercises are classified as Preliminary and Deformity Correcting. The purpose of the preliminary exercises is:

1. To train the patient to take the starting positions and the simplest variations accurately;

2. To "limber up" the stiffened muscles and ligaments of the trunk, the shoulder girdle and the hip-joints; and

3. To start the correction of the exaggerated antero-posterior spinal curves.

All of the *preliminary exercises* are symmetrical.

I. Kneeling.
   1. With hands on hips; trunk bending forward.
   2. Alternate foot placing forward.

II. On hands and knees.
   1. Alternate head and mid-back raising.
   2. Trunk swaying forward to prone lying, then backward to resting on heels.
   3. Alternate thigh extensions backward to horizontal.
   4. Alternate arm extensions forward.

FIG. 9—Exercise II, 2. To lessen spinal deviation, to lessen winged shoulder and rotation (especially lumbar) and to lessen hollow back.

FIG. 10—Exercise II, 3. Powerfully affecting all elements of the deformity.

III. Prone lying.

1. "Seal"—with hands clasped low behind the back; raise head and shoulders and arms.

IV. Lying on back.

1. With knees drawn up (feet resting on the floor); bend both knees to the chest.

2. With arm stretched upward beyond the head; arm flinging forward, raise trunk to sitting, to forward reach to toes.

FIG. 11—Exercise III, 1. To lessen winged right shoulder and to develop right vertebro-scapular muscles. Very little effect upon lumbar deformities.

V. Half prone lying at end of table.

1. Alternate thigh raising to horizontal (knee straight).

2. Raising both thighs to horizontal (knees straight).

3. With arms stretched out at sides; raise head and shoulders and arms.

VI. Sitting.

1. With feet apart and dumbbell on floor between; raise weight floor to right shoulder, to high, to shoulder, to floor, to left shoulder, to high, to shoulder, to floor.

About a week is sufficient time to give to the preliminary exercises.

The intensive corrective exercises are progressively based on the preliminary exercises. They are asymmetrical. They aim definitely to correct the specific features of the deformity (See Fig. 1.)—the upper side trunk-lean, the low shoulder, the compound spinal deviation, the exaggerated antero-posterior curves, and especially the rotations. It is believed that this is accomplished by actively and progressively using the muscles which must be depended upon to maintain these corrections. For clearness of wording, the type—right dorsal left lumbar—is here chosen. Modifications of the following exercises must be chosen in variations from this type.

Fig. 12—Exercise IV, 2. To develop abdominal muscles (especially of the left side) and to affect all elements of the deformity.

Intensive *Corrective* (Rotation) *Exercises.*

I. Kneeling. (Fig. 5.)

1. With cane in hands; bend trunk forward to the left, reaching left side of cane far forward to the left, carrying right arm (half bent) sideways upward, with upper trunk twist to the right. (Fig. 6.)

II. On hands and knees. (Fig. 7.)

1. Stretch right thigh backward and left arm forward (synchronous movement). (Fig. 8.)

2. Place left foot forward on the floor and raise right arm sideways upward with upper trunk twist to the right (synchronous movement). (Fig. 9.) (Later).

3. Stretch right thigh far backward, sway trunk backward (to sitting on left heel), raise right arm sideways upward, twisting upper trunk to the right (synchronous movement). (Fig. 10.)

III. Prone lying.

1. With left arm forward (to the left) on the floor, head resting on left arm, and with right arm out sideways on the floor; raise right arm sideways upward with upper trunk-twist to the right. (Fig. 11.)

(Later, with increasing dumbbell weight in right hand).

IV. Lying on back.

1. With knees drawn up (feet resting on the floor); keeping knees parallel, bend toward the chest, twisting so that knees point to the right (feet to the left).

2. With arms over head on the floor; raise trunk to sitting, to left hand touch to left toe and with right arm raising sideways upward and upper trunk twist to the right (synchronous movement). (Fig. 12.)

V. Half prone lying at end of table (feet on floor). (Fig. 13.)

1. With upper trunk placed to the left on the table, left arm reaching far forward to grasp left side of table and right arm stretched out sideways; raise right thigh to horizontal (knee straight) and raise right arm sideways upward (synchronous movement). (Fig. 14.)

(Later, add increasing dumbbell weight in right hand.)

2. (Later) Repeat V. 1, but raising both thighs to horizontal (gradually getting an increasing twist to the low spine, by elevating the left hip and thigh).

VI. Left thigh support sitting on bench—"spring sitting."

1. The left thigh is supported on the bench, the right thigh-leg-foot is stretched far backward, a dumbbell is held at each shoulder; bend trunk forward to the left, reaching left arm forward (over left knee) to the floor, raise right arm sideways upward, with upper trunk twist to the right (synchronous movement). (Fig. 15.)

2. Left hand-support "spring sitting"—The left hand rests on a table far forward, the remainder of the body in spring sitting; raise right arm sideways upward with upper trunk twist to the right. (Fig. 16.)

The above exercises are planned with the least apparatus possible, so that the patient may do them at home daily. Where the operator wishes to keep entire control of all of the exercises in his own gymnasium, much elaboration will suggest itself and such apparatus as the Swedish plinth, stall bars and bom, will add to the effectiveness of much of this. The writer outlines an exercise program as follows: (1) For first month, at office gymnasium once a

FIG. 13—The starting position. V. Half prone lying at end of table.

week, (2) for second month, two office visits, (3) thereafter, once a month at office gymnasium. This is supplemented with a written gymnasium prescription (GR) of daily home exercises, which is added to usually at each visit.

Experience has shown that these exercises are truly corrective and especially of the rotation deformity.

Now, to estimate the relative merits of the three procedures and the amount of time to be given to each:

1. The corrective plaster jacket lessens deformity more rapidly than does brace-wearing or exercises. It affects rotation least of all of the elements of deformity. It has distinct time limitation because of skin-pressure intolerance and because of the patient's attitude toward it. It must be re-assumed after a shorter interval of bracing and exercises in the paralytic spine patient.

FIG. 14—Exercise V, 1. Passively correcting low shoulder and upper trunk-lean and hollow-back, and lessening spinal deviation; actively lessening winged right-shoulder and rotation.

FIG. 15—Exercise VI, 1. Actively affecting all elements of the deformity, but especially spinal deviation and rotation.

2. The retentive brace alone will delay deformity formation. It will bring about no correction of it, and unless constantly cared for, will allow increase in deformity. It is inadequate in the paralytic spine.

3. Exercises alone will not be sufficient to prevent an increase in a deformity in which the ratio of deviation is greater than four per cent. It must be used with very gradual progression in the paralytic. When reinforced by an efficient retention brace and intermitted with an occasional short return to the corrective jacket, it is the best means available for insuring a stopping

Fig. 16—Exercise VI, 2. While passively correcting spinal deviation, low shoulder and upper trunk lean, to concentrate actively on lessening winged shoulder and rotation.

of deformity progress, for insuring a large amount of deformity lessening, and, by its general hygienic, as well as local effect, for a reasonable assurance of non-return of deformity.

As to time necessary, one would say that a structural scoliosis presenting five per cent deviation or less would require about one year of active treatment—plaster corrective jackets for three months, nine months of retentive brace and intensive supervised exercises; and that in the second year a girl could wear a

simpler reinforced corset and do her home exercises daily, with occasional supervision of the doctor. A ratio of deviation of five to ten per cent would require three months of corrective jackets; six months of retentive brace and intensive exercises; three months of corrective jackets, and a second year of bracing and supervised exercises. Greater amounts of deformity would require longer time. The paralytic, if treated non-operatively, must have a larger proportion of the time given to the corrective jacket and must be carried on for several years.

Summary:

1. Successful treatment of structural scoliosis must depend upon a clear understanding of the elements of deformity, and the lessening, if not complete elimination, of all of them.

2. Uniform and regular measurement and numerical record of the elements of deformity are important as guides to continuance of treatment and as indicating elements most needing correcion.

3. A balanced use of corrective plaster-of-Paris jackets, of retention brace and of intensive exercises is essential to satisfactory results.

4. The position of the patient when the plaster jacket is applied is responsible for improving body posture and shoulder carriage; the successive paddings, for care of the spinal deviation and the rotation.

5. Essentials of a retention brace are (a) ability to hold correction attained; (b) application by the patient with reasonable accuracy; (c) extensibility and lateral compressibility to meet normal growth and progressive deformity decrease; (d) mechanical self-correction by the brace seems possible, but not yet fully attained.

6. Gymnastic exercises must be progressive, intensive and with a minimum of erect weight-bearing. They must aim to correct all of the elements of deformity, especially that of rotation. Starting positions other than standing facilitate these ends.

7. Retention of deformity correction attained must be maintained while exercise is developing natural muscular support. Artificial support may gradually give way to natural support. The paralytic scoliotic must receive a larger proportion of artificial support than will be required for those not paralyzed in the trunk muscles. Internal splinting, by operative bone-fixation, may also be necessary in severe paralytic cases.

MEMORIAL TO ARTHUR J. GILLETTE, M. D.

From the University of Minnesota

The name of Arthur J. Gillette has to be added by the Faculty of the Medical School of the University of Minnesota to the long chapter roll of its remembered and honored dead. To review the record of his life is to measure the regret of his associates that he has gone.

Success comes to many, as it came to him; but success with distinction is won, as he won it, by few. The genial nature, the kindly humor, the punctilious courtesy, the careful professionalism, like the diagnostic fingers and the analytic mind of the man, were peculiarly his own. There was a strongly personal quality in everything he did which made for the large sum of appreciation he received from his fellows.

He was essentially a son of his State. One of the pioneer students of medicine in Minnesota, he attended the Minnesota Hospital College from 1883 to 1885; he transferred his allegiance to the reorganized St. Paul Medical College in 1886; and he graduated in that year. In 1903 he took the ad eundem degree of the University of Minnesota.

In 1895 he began his notable career as a medical educator, accepting, first, an instructorship in Orthopedia; becoming a clinical professor in 1897; a full professor of orthopedic surgery in 1898; and taking charge of this Division in 1913.

In 1915 he resigned, as he said "in favor of some younger and better man." Urged by the Faculty to withdraw his resignation, he consented to continue his work but left his resignation in the hands of the School to be considered whenever the time should come to determine the limit of his usefulness. That time did not come and his resignation, still on file, has been accepted by death.

The one great ambition of his life, The Hospital for the Crippled and Deformed at Phalen Park, the first institution of its kind in America, stands as his personal and professional monument. He conceived it; he inspired the gift of the acreage upon

which it stands; he framed and promoted the legislation which created it; he superintended its construction; he directed its activities throughout its history; he determined that its staff should be of the University Faculty. A model of its kind, a noble institution of the State, an educational asset to the University, it has been, under his inspiration, more than all these,—a place of light and leadership, of human love and human service.

Service was the key-note of the life of Arthur Gillette; its one great purpose to promote the happiness of the handicapped. The smiles and the laughter of little children whose lives he lengthened, whose sufferings he assuaged, whose deformities he corrected, whose health he restored, whose usefulness and satisfaction he assured, will be his welcome in the world to which he has gone, as they were the light and the music of the world that he has left.

AMERICAN ORTHOPEDIC ASSOCIATION

Annual 35th Session

Boston, Mass., June 2, 3, 4 and 6, 1921

MEETINGS HELD IN BOSTON MEDICAL LIBRARY

PROGRAM

THURSDAY

June 2, 1921

9:00 A. M. **Presidential Address.** Dr. Robert B. Osgood.

Lessons from My Experience with Congenital Dislocation at the Hips. Dr. John Ridlon.

Congenital Hip Commission Report. Dr. Joel E. Goldthwait, Dr. Z. B. Adams, and Dr. DeForest Willard.

Discussion to be opened by Dr. E. H. Bradford, Dr. H. L. Taylor, Dr. H. P. H. Galloway.

Arthroplasty. Dr. Vittorio Putti.

Discussion to be opened by Dr. C. L. Starr and Dr. W. S. Baer.

Executive Session.

Luncheon.

Bone Sarcoma. Dr. R. B. Greenough, Dr. C. C. Simmons, Dr. W. Harmer.

Discussion to be opened by Dr. E. A. Codman and Dr. W. G. Stern.

Infantile Paralysis. Dr. R. W. Lovett.

Discussion to be opened by Dr. M. Hoke and Dr. A. Steindler.

End Results in the Operative Procedures for Infantile Paralysis with Special Reference to Tendon Transplantations at the Widener Industrial Training School for Crippled Children. Dr. A. Bruce Gill.

Discussion to be opened by Dr. R. T. Taylor and Dr. J. L. Porter.

Some Views on the Immobilization Treatment of Septic Arthritis of the Knee. Dr. F. R. Ober.

Discussion to be opened by Dr. W. G. Turner and Dr. R. R. Fitch.

Unusual Destructive Lesions of the Bodies of the Vertebrae in Adults. Dr. F. C. Kidner.

Discussion to be opened by Dr. P. W. Roberts and Dr. W. G. Stern.

Myeloma of the Vertebrae. Dr. W. G. Turner.

Discussion to be opened by Dr. P. W. Roberts and W. G. Stern.

The Teaching of Orthopedic Surgery. Dr. Nathaniel Allison.

Discussion to be opened by Dr. R. W. Lovett, and Dr. C. F. Painter.

EVENING SESSION—8:00 P. M.

Ten-Minute Addresses

An Historical Review of Surgical Methods in the Treatment of Spine Injuries. Dr. H. Winnett Orr.
Discussion to be opened by Dr. E. G. Brackett and Dr. G. W. Hawley.

Amyotonia Congenita of Oppenheim with Case Report. Dr. Charles A. Stone.
Discussion to be opened by Dr. Nathaniel Allison.

Lengthening of the Quadriceps Tendon for Mobility of the Knee Joint—End Results and Moving Pictures. Dr. G. E. Bennett.
Discussion to be opened by Dr. DeForest Willard and Dr. W. S. Baer.

Sympathetic Segmental Disturbances, or the Association of Visceral Diseases with Minor Spinal Curvatures of the same Sympathetic Segments. Dr. Henry Winsor.
Discussion to be opened by Dr. John Dane.

FRIDAY
June 3, 1921

9:00 A. M. **Sur un nouveau traitement de la paraplegie pottique. Sur l'osteo-chondrite infantile de la hanche. (Maladie de Legg-Calve.)** Dr. Jacques Calve.
Discussion to be opened by Dr. F. H. Albee and Dr. F. J. Gaenslen.

Commission Report on Ankylosing Operation on the Spine. Dr. E. G. Brackett, Dr. J. T. Rugh, and Dr. W. S. Baer.
Discussion to be opened by Dr. David Silver and Dr. E. W. Ryerson.

Army Experiences with Tendon Transferences—End Results. Dr. Clarence L. Starr.
Discussion to be opened by Sir Robert Jones.

Operative Treatment and End Results in Disabilities of the Arm and Shoulder. Dr. Arthur Steindler.
Discussion to be opened by Dr. J. W. Sever and Dr. E. S. Geist.

Arthroplasty of the Knee—Report of Cases. Dr. W. C. Campbell.
Discussion to be opened by Dr. J. T. Rugh and Dr. H. L. Prince.

1:00-2:00 **Luncheon.**

Symposium on Fractures

2:00- **Manipulation of Stiff Joints.** Sir Robert Jones.

End Results in Fractures of the Hip—Fracture Service of Massachusetts General Hospital. Dr. D. F. Jones and Associates.

End Result Fractures of the Femur. Dr. M. S. Henderson.

Treatment of Fractures of the Femur. Dr. F. E. Peckham

End Result Fractures of the Lower Leg. Dr. E. W. Ryerson.

Bone and Joint Fractures of the Knee and Ankle. Dr. G. W. Hawley.

Fractures of the Elbow in Children. Dr. J. S. Stone.

The Treatment of Sprain—Fracture of the Tubercle of the Tibia in Adolescence (Osgood-Schlatter Disease); Lantern Slides. Dr. Robert E. Soule.

Discussion on all papers to be opened by Dr. Joel E. Goldthwaite and Dr. H. Winnet Orr.

7:00 P. M. **Dinner at Algonquin Club.**

SATURDAY

June 4, 1921

9:00 **Peripheral Nerve Injuries.** Dr. Harry Platt.

Discussion to be opened by Dr. W. E. Gallie and Dr. M. S. Danforth.

The Stabilization of Paralytic Feet. Lantern Slides.. Dr. Michael Hoke

Discussion to be opened by Dr. A. B. Gill and Dr. Charlton Wallace.

Report of Results of Cuneiform Osteotomy of the Neck of the Astragalus in Paralytic Talipes Equino Valgus, and Varus Plus Pes Cavus. Dr. Compton Reilly.

Discussion to be opened by Dr. J. A. O'Reilly and Dr. M. H. Rogers.

Congenital Club Feet (General and Present Methods in the Treatment of). Dr. Eben W. Fiske.

Discussion to be opened by Dr. A. H. Freiberg and Dr. F. R. Ober.

A Clinical and Experimental Study of the Application of Free Transplants of Fascia and Tendon in Orthopedic Surgery. Dr. W. E. Gallie and Dr. A. B. LeMesurier.

Discussion to be opened by Dr. David Silver and Dr. W. W. Plummer.

Commission on Stabilizing Operations Upon the Foot. Dr. A. G. Cook, Dr. R. R. Fitch, and Dr. W. G. Stern.

Discussion to be opened by Dr. DeForest Willard.

12:00 **Executive Session.**

P. M. **Canton.** Massachusetts Hospital School for Crippled and Deformed Children.

TO BE READ BY TITLE

The Pathology of Two Unusual Cases of Contracture. Dr. Sydney M. Cone.

A Report of Three Cases of Avulsion or Fracture of the Lesser Trochanter. Dr. C. F. Eikenbary.

The Control of the Anterior Arch in Selected Cases of Morton's Toe. Dr. Roland C. Meisenbach.

Certain Inconsistent Deductions from the Surgery of the Great War. Dr. Fred H. Albee.

The Treatment of Caries of the Spine. Methods of Recording Scoliosis. Studies in Spinal Side Flexibility and Congenital Dislocation of the Hip. Dr. E. H. Bradford.

An X-ray and Anatomical Study of the Lumbo-Sacral Region. Dr. J. A. O'Reilly.

An Operation for the Treatment of Severe Acetabular Disease. Fracture Reduction with the Aid of a Simple Traction Apparatus. Pulmonary Edema Following Pott's Disease. Dr. Robert Soutter.

Reconstruction of the Internal Lateral Ligament of the Knee Joint. Dr. John C. Wilson.

MONDAY

June 6, 1921

Clinical Day

Building E. Harvard Medical School

9:00 Sir Robert Jones. Diagnostic Clinic.

Dr. Vittorio Putti. Diagnostic Clinic.

Dr. M. N. Smith-Petersen. Arthrodesis Sacro-Iliac Joint; A New Method of Approach.

Dr. R. B. Osgood. Radio-Humeral Bursitis.

Dr. Hat. Stoeffel Operation on Adults.

Dr. Vitterio Putti. Arthroplasty of Knee Joint Operation on Cadaver.

Dr. W. R. MacAusland. Arthroplasty of the Elbow. Moving Pictures.

Dr. J. D. Adams. A Series of Claw-foot Cases Showing the Results of Jones Operation.

Sir Robert Jones. Operation on Cadaver.

1:00- 2:00 Luncheon.

Anatomical Demonstration to be held in Building B, Harvard Medical School

Monday, June 6th, 1921

2 O'clock

Harvard Medical School, Building E.

	Time
Frame for Fasciotomy—Dr. S. F. Stewart	5
Shell, lid, and arm piece—Dr. R. P. Schwartz & Dr. Li	10
Plaster cuirass—Dr. Robert Soutter	10
New apparatus for congenital hip—Dr. E. H. Bradford	10
Lantern Slides of bone affections—Dr. Robert W. Lovett	20
End Results—flattened head of the femur—Dr. Arthur T. Legg	10
Pathological aspect of human and bovine tuberculosis—Professor S. B. Wolbach	15
Milk and tuberculosis—Professor M. J. Rosenau	15
Surgical aspects of milk borne tuberculosis—Sir Robert Jones	10

Anatomical Operative Demonstrations

Building B, 4 O'clock

Fasciotomy—Dr. Robert Soutter	10
Obstetrical paralysis—Dr. James Warren Sever	10
Fascia transplantation—Dr. Arthur T. Legg	10
Club Foot—Dr. Frank R. Ober	10
Decompression in spastic paralysis—Dr. Harvey Cushing	15

News Notes

There was recently formed in Los Angeles and vicinity an organization known as the Los Angeles Orthopedic Society.

The society plans to hold five regular meetings yearly as follows: the second Monday of January, March, May, September ard November.

The first regular meeting was held at the Los Angeles City Club, March 14, 1921, at which there was a dinner followed by the election of officers and a scientific program. The offlcers elected were as follows:

W. W. Richardson, M. D.	President
C. L. Lowman, M. D.	Vice President
Alfred E. Gallant, M. D.	Secretary-Treasurer

The roster of membership included the following:

Name	City
Chappel, H. W.	Los Angeles
Dunlop, John	Los Angeles
Gallant, Alfred E.	Los Angeles
Hart, Trusten	Los Angeles
Koebig, Walter E.	Los Angeles
Lowman, C. L.	Los Angeles
Lokrunz, Sven.	Los Angeles
Pyles, Richard H.	Los Angeles
Reed, E. N.	Los Angeles
Richardson, W. W.	Los Angeles
Rue, Homer	Los Angeles
Splers, H. W.	Los Angeles
Wllson, John C.	Los Angeles
Young, Chas. S.	Los Angeles
Los Angeles vicinity:	
Clark, William Arthur	Pasadena
Brown, Scott J.	Long Beach
Galvin, A. H.	Anaheim

The program for the first regular meeting was as follows:

1. Surgical Importance of Torsion Deformities (with lantern slides) by C. L. Lowman, M. D.

2. Symposium of the literature on Astragalectomies, by H. W. Chappel, M. D.

Both papers were interesting and evoked considerable discussion.

Two men who have long been prominent in Orthopedic work, Joseph Kurtz, M. D., of Los Angeles, and John P. Lord, M. D., of Omaha, Neb., were made honorary members of the society.

The next regular meeting will be held the second Monday in May, at which time the society hopes to have the members of the Pacific Coast Orthopedic Society as its guests.

Announcement has been received of the formation of the Lexington Clinic at 190 No. Upper Street, Lexington, Kentucky. Dr. C. C. Garr is the Orthopedic Surgeon associated with the Clinic.

Dr. Joseph M. Spellissy of Philadelphia who was seriously injured in a motor accident some months ago has now nearly recovered. He sustained a fractured femur and other injuries. Dr. James K. Young writes that during Dr. Spellissy's confinement to the hospital he devised a very ingenious lifting apparatus.

The New York Orthopaedic Hospital and Dispensary has received $25,000.00 by the will of Mrs. Elizabeth Southmayed, who died in New York City March 31.

Dr. Wallace Blanchard has resigned, after 27 years of service, from the Clinic at The Hospital for Destitute Crippled Children, Chicago. Dr. E. J. Berkheiser, who has been associated with Dr. Ridlon, will have charge of the Clinic on Tuesday and Friday.

Orthopaedic Titles in Current Literature

Frepared by Dr. J. E. M. Thomson, Lincoln, Nebraska.

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Bidon, Grabriel. Paris. Instrumental Orthopedics. Jan. 21, 1921, 45, No. 2, p. 35.

Blanco, Pio. Giant-Cell Tumor in the Knee Joint; Report of a Case. J. of Orthopaedic Surg., April, 1921, Vol. 3, No. 4, p. 156.

Bloodgood, J. C. Bone Tumors; Myxoma, Central and Periosteal. Ann. Surg., 1920, LXXII, p. 712.

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Bosch, Arana, G. Osteosarcomata of the Radius Treated by Resection and Fibular Grafts. Semana med., 1920, XXVII, p. 801.

Bradford, E. H. Flat-Foot: a Simple Method of Treatment. Internat. J. Surg., 1920, XVIII, p. 143.

Brning. Treatment of Rachitic Curvatures. Deutsche Medizinische Wochenschrift, Berlin, Dec. 28, 1920, 46, No. 52, p. 1437.

Beresford, G. W. Ununited Fractures. Brit. Med. J. Mar. 26, 1921, 1, No. 3, p. 456.

Chelmonski, A. Alimentary Disease of Bone. Presse Medicale, Paris, Feb. 9, 1921, 29, No. 12, p. 115.

Clark, William Arthur. A Protractor for Measuring Rotation of Joints. J. of Orthopaedic Surg., April, 1921, Vol. 3, No. 4, p. 154.

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Collins, A. W. Fracture Reduction and Fixation with a Specially Designed Band. Archives of Surgery, Mar., 1921, 2, No. 2, p. 354.

Cramer. Snapping Hip. Ztschr. f. aerztl., 1920, XVII, p. 525.

David, V. C. The Treatment of Acute Suppurative Arthritis of the Knee Joint. Surg. Clin., Chicago, 1920, IV, p. 1253.

Debrunner, H. The Function of the Abductor Hallucis Muscle and Its Relation to Hallux Valgus and Flat-Foot. Arch. f. Orthop., 1920, XVIII, p. 143.

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Dejerine, (Mme.) and A. Ceillier. Para-Osteo-Arthropathy Medicine, Paris, Feb., 1921, 2, No. 5, p. 363.

Dickson, J. A. Treatment of Stiff Metacarpophalangeal Joints Where There Is no Gross Bony Alteration. Jan., 1921, 8, No. 31, p. 272.

Dollinger, B. Congenital Luxation of Both Radii. Orvosi hetil., 1920, LXIV, p. 349.

Dubs, J. Isolated Dislocation of the Humeroradial Articulation and Epicondylitis. Schweiz. Med. Wchnschr., 1920, 1, p. 778.

Edwards, A. H. Operative Procedure for Repair of Collateral Ligaments of Knee-Joint. British J. of Surg., Jan., 1921, 8, No. 31, p. 266.

Ewing, D. A. Dislocation of Carpal Scaphoid. J. A. M. A., April 16, 1921, Vol. 76, No. 16, p. 1078.

Fischer, A. E. The Treatment of Fistulae Following Gunshot Injuries of the Bones and Osteomyelitis. Zentralbl. f. Chir., 1920, XLVII, p. 1167.

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Goeldel, W. The Causation and Treatment of Epicondylitis. Muenchen. med. Wchnschr., 1920, LXVII, 1147.

Goldstein, M. Hand-Forearm Reflex and First Phalanx Reflex. Dec. 17, 1920, 77, No. 51, p. 1460.

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Hare, D. C., and C. C. Bernard. Case of Osteitis Deformans. Feb. 19, 1921, 1, No. 5086, p. 37.

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Howard, W. P. Fracture of the Tarsal Scaphoid With Dorsal Dislocation of the Lower Fragment. Albany M. Ann., 1920, XLI, p. 406.

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Vol. 3, No. 6 JUNE, 1921 Old Series Vol. XIX, No. 6

The Journal *of* Orthopædic Surgery

PRESIDENTIAL ADDRESS 1921

BACKGROUNDS OF ORTHOPAEDIC SURGERY

BY ROBERT B. OSGOOD, M. D.

Fellows of the American Orthopedic Association, honorable colleagues from overseas, friendly guests: on behalf of the Boston members of the Association I extend to you a most cordial and sincere welcome.

It is my sad duty to record the death during the year of two eminent members of the Association, Dr. Arthur J. Gillette, on March 23, 1921, and Dr. Harry Sherman, on May 15, 1921. Their obituaries will be delivered at the first Executive Session.

Thirty-two years ago the third President of the American Orthopedic Association, Dr. E. H. Bradford, read before you an address on the History of Orthopedic Surgery, describing its development and outlining its future obligations.

Such a review furnishes a background by which we may judge the color values of our own effort. If certain ill conceived attempts have temporarily marred the picture, their discordant colors have faded into the whole, and against this background we may now recognize the clear cut image of new achievement.

It is possible that we may again with profit briefly review the work of a few masters. We shall make no attempt to cover the walls of the Orthopedic Hall of Fame with many well deserving names, but in stating what seem to us to be the essential principles of the specialty we shall pay tribute to a few great men who have embodied these principles in a peculiar way, demonstrating their soundness by the convincing success of their application.

I.

The Prevention of Deformity

The first clear voice which proclaims this chiefest aim is heard in France. It is that of Andry, who gave us the name "orthopaedia" in a two volume work published in the middle of the eighteenth century, (1743). "On the Art of Preventing Deformity in Children." He was at this time Professor of Medicine in the Royal College and Senior Dean of the Faculty of Physik at Paris. The titles of some of his chapters might head the writings of today, "The Means of Preventing the Bellies of Children from Projecting Too much Forward and How to Keep Their Backs Streight," "How They Ought to Sit to Produce This Effect: Particular Seats for This Purpose."

In Andry's treatment of existing deformity there is a strange mixture of tradition and common sense. Thus, in correcting a contraction of the Tendo Achilles, he strongly advocates rubbing the calf with "oil of worms" and bathing the leg frequently with a "bucket of tripe broth moderately warm." In addition, however, he directs these patients to persist in climbing the mountain of Sainte Genevieve and to tramp in the ditches of St. Victor.

In an elaborate thesis defended before the College of Physicians, he extols exercise as the great preventor of disease and the corrector of deformity, far more potent than unpleasant medicines which become so changed before they reach the blood that in great measure they lose their force. "Exercise is so useful and necessary that not only man, but the most inactive and indolent of the brute creation, nay even the plants themselves, cannot thrive without it. The humble violet as well as the lofty oak loves to be agitated by the winds."

If Andry was unable quite to shake off the shackles of an empirical and fanciful therapy, these shackles did not bind him nor did the occasional rattling of their chains make less distinct his loud call to more natural methods of cure.

II.

Rest as a Curative Agent in Diseases and Injuries of the Bones and Joints

England speaks in the person of John Hilton in the nineteenth century. "By regarding this subject of physiology and mechanical

rest in what I conceive to be its proper professional light, the surgeon will be compelled to admit that *he has no power to repair directly* any injury. It will induce him to acknowledge in all humility that it is the prerogative of nature alone to repair the waste of any structure; he will then realize that his chief duty consists in ascertaining and removing the impediments which obstruct the reparative process or thwart the effort of nature and thus enable her to restore the parts to their normal condition."

This acknowledgement of the limitations of surgery, this tribute to the potency of natural forces, did not come from one untrained or unskilled in surgery. At eighteen, he had entered the dissecting room of Guy's Hospital, and for over twenty years earned his living by demonstrating anatomy and physiology and performing post mortems. Then for twelve years he was Surgeon to Guy's and for twenty-five of the last years of his life a successful practitioner much in the public eye.

And if Hilton pursued the road of "rest" after it had become a byway and not the straight, short route to full function, he yet cleared a path which had become obscured, and this path has ever since remained open for us to follow in safety until we find a more sure and expeditious way to a common goal.

III.

The Rational Mechanics of Rest and Protection Necessary to the Successful Application of this Therapeutic Principle.

It required the analytical mind and mechanical ingenuity of Hugh Owen Thomas, another famous Briton, to make possible the procurement of this rest with greatest completeness and least discomfort to the patient.

Thomas was no mean surgeon, but it was his final belief that in bone and joint lesions the skillful use of the blacksmith's hammer could be depended on to bring about more cures than the knife of the surgeon. He came from a race of bonesetters and held no great teaching or hospital positions. His experience was gained from the droves of patients, mostly wage earners, who flocked to 11 Nelson Street, Liverpool, because they had learned that here relief from their physical ills could be found, as nowhere else. But

this was not all: sympathetic understanding of their mental distress was even surer than the benison of ease from pain. Rich and poor alike received this therapy of their souls. He died before his three score years, but not before, as a Fellow of the Royal College, he was recognized as a great surgeon and a master mind.

When we realize that the simple and mechanically perfect splints devised by him and his great inheritor, (Sir Robert Jones) who is fortunately with us today, saved more suffering and prevented more deformity than any other surgical method employed in the great war, we may in some measure appreciate the amount of tribute with which we should honor him and the magnitude of the debt we owe him. We as orthopaedic surgeons will never escape from the necessity of training ourselves in the use of apparatus nor in developing the faculty of invention by which we may be enabled to devise physical means which shall most perfectly fulfill the requirements demanded by an understanding of bodily mechanics.

IV.

Research and the Physiology of Surgery as Applied to Lesions of the Extremities and Spinal Column.

Whom shall we select from the not too great number of bone and joint surgeons who have appreciated the supreme importance of this method of attack? Perhaps Ollier, Professor of Clinical Surgery in the University of Lyons and Surgeon to the Hotel Dieu during the middle years of the 19th century. Ollier may be said to be the first great surgeon who recognized experimental physiology as the essential basis of all surgery. Like Lister, his great contemporary, he spent the first ten years of his professional life in physiological research. He possessed an open, unprejudiced mind so necessary to all who would search honestly for truth. Believing that the periosteum played no part in new bone formation, he became as a result of his experiments a disciple of Duhamel and Flourens, who held a diametrically opposite opinion.

That the true conception concerning the osteogenetic or non-osteogenetic function of the periosteum probably depends upon what elements we elect to include in the term "periosteum" detracts not one whit from the value of the experiments of Ollier or of Sir William MacEwen, that other great and almost contempo-

raneous physiological surgeon whose conclusions were opposed to Ollier's. An extraordinary number of fundamental conceptions concerning the growth and reaction of bone have sprung from the mind and work of Ollier. He typifies to us the spirit of patient unprejudiced research, eternally necessary to real progress in medicine.

"Of toil unsevered from tranquility
Of Labor that in lasting fruit outgrows
Far noisier schemes; accomplished in repose
Too great for haste, too high for rivalry."

V.

Anatomical Knowledge, General Training, and Technical Skill in Surgery.

To Italy we must turn for the most complete embodiment of these requirements of the Orthopaedic Surgeon.

Alessandro Codivilla, who died before his time and within the memory of all of us, devoted to the service of the art, an acute mind, a great heart, a modest forceful personality, and skill as a surgeon second to none. His Doctorate was received at twenty-five, and after many years of work as a general surgeon, during which time he made lasting contributions to the surgery of the brain and stomach, he became Professor of Orthopaedic Surgery in the University of Bologna and Director of the famous Istituto Rizzoli. He had always before him the broad humanitarian ideas of its founder and was universally recognized as the chief orthopaedic surgeon of Italy.

In Great Britain the foundations of the present orthopaedic surgery may be said to have been laid by William John Little; in France it was dignified and advanced by Jacques Delpech; in Italy its renaissance is due almost solely to Codivilla. To him we of this generation owe many things: valuable methods of reduction of congenital dislocation of the hip, the niceties of amputation technique, tendon transplantation and tenodesis, direct traction on bones for the reduction and alignment of fractures, osteoperiosteal bone grafts. But more than all we delight to name him an orthopaedic surgeon because after attaining eminence as a general surgeon, he devoted his life to that art which, as Biesalski has said, "requires

profundity of knowledge and acuteness and fineness of mind and hand perhaps more than any other branch of surgery."

It is with genuine pleasure that we welcome another eminent Italian surgeon (Prof. Vittorio Putti) whose flaming torch has been lit by Codivilla's fires.

VI.

THE SEGREGATION OF ORTHOPAEDIC CASES UNDER SPECIALLY TRAINED SURGICAL AND NURSING GROUPS. HOSPITALS FOR CRIPPLED AND DEFORMED CHILDREN. ORTHOPAEDIC DEPARTMENTS OF GENERAL HOSPITALS FOR ADULTS AND CHILDREN UNDER THE DIRECTION OF SURGEONS SPECIALIZING IN THE CARE OF THE HANDICAPPED.

Perhaps we shall be forgiven if with local pride we call attention to the fact that Buckminster Brown of Boston, charter member of this Association, succeeded in establishing a special ward for the treatment of deformities, which was the first in this country set aside for this purpose. This was in the House of the Good Samaritan in 1861, and was followed by the Hospital for the Ruptured and Crippled in New York in 1863.

There is now a concensus of qualified opinion that in all fields of orthopaedic work the most complete restoration of function in the shortest possible time and with the least suffering to the patient can most perfectly be attained by grouping these cases in special hospitals or departments of hospitals. Mechanical devices, physiotherapeutic methods, and the details of special operative technique require trained teams not found among general medical or surgical groups. We may, moreover, thus most surely create an atmosphere which induces that attitude of mind so necessary to the mental and physical recovery of the handicapped.

Brown, himself a cripple like Little, realized this truth, and was the first surgeon in America to devote his professional life to Orthopaedic Surgery. So from the little ward in the Hospital of the Good Samaritan spread this specialized hospital care which we all recognize today is both scientific and humanitarian.

To these spirits of the restoration of function in deformity and disease we owe the debt of continued endeavor.

I have reminded you of these colleagues of many lands not because you are ignorant of their stature, but because the truths for

which they lived and died do not change, and we can progress only by sensing these truths as the background of our work.

We venture, without authority, but with conviction, to sketch the foreground.

No one can read The Cameron Prize essay of Sir Robert Jones without being stirred by the opportunity which the widening scope of Orthopaedic Surgery presents. When the great conservative University of Edinburgh establishes a chair of Orthopaedic Surgery it is a recognition which imposes a sober responsibility upon the specialty.

It is perhaps not wise for us yet to lay down finally the lance of the Crusader, but at least we are not forced to struggle longer for a place in the sun. Orthopaedic Surgery, by the achievements of its dead and living exponents, has received its meed of recognition and praise from the Profession of Medicine, nor, by and large, has this recognition been grudgingly granted. It is rather for us today to seek a closer contact, to feel more keenly the stimulation of rivalry in the acquirement of anatomical and pathological knowledge and the attainment of skillful and gentle surgical technique and perfect asepsis.

We fully recognize that brilliant operative ability is not the only nor the main goal. Perhaps the major part of orthopaedic practice will in the future be concerned with the prevention of disease and deformity. But if we essay to be trusted with the knife, if we call ourselves surgeons, we must be so in very fact. We have often felt justified in criticising the work of general surgeons in bone and joint lesions. Our own work, therefore, must not be unfavorably compared with the best which General Surgery and the other surgical branches exhibit. If we do not measure up to these standards we in turn may be rightly criticised for attempting that for which we are untrained, no matter how brilliant may be our bloodless methods of functional restoration.

If we attempt only that for which our training has fitted us, and without reserve or embarassment admit our individual limitations, turning to those within our ranks or outside for the help which their fuller training can render, we shall enhance the respect in which we are held and serve our patients more honestly.

We would not be misunderstood. We plead for the most complete early training in general surgery of all those who would be-

come Orthopaedic Surgeons. We have very fortunately a rapidly increasing group of men who have been so trained, both within the Association and without.

We believe the day is near when it will be generally recognized that a new problem in the Surgery of the Extremities and Spinal Column is more likely to be solved by an orthopaedic surgeon than by any other. We believe it is already recognized that an orthopaedic surgeon, whose training is equal to that of a general surgeon of comparable ability, will probably obtain better results in the treatment of fresh, simple and compound fractures than his general surgical colleague.

Yet today some of us, among whom your President most definitely includes himself, must realize that in certain cases, hav-made clear the principles which must underlie the restoration of function, we must be ready to delegate to others the carrying out of the details of the operative procedure necessary to the fulfillment of our purpose. We must do this or else patiently train ourselves to the accuracy of operative technique which the case requires.

This is but a temporary limitation, a passing phase in the growth of Orthopaedic Surgery, but we shall do well to recognize the phase.

In what fundamental science do we most need at the present time to train ourselves, if we would surely contribute our part to the advancement of medicine and surgery? We believe in physiology. We need sorely research workers. The field has rich soil, as is shown by the brilliant contributions to medical knowledge of certain of our members who have contrived to steal time from the confusion of clinical work and to spend quiet, fruitful hours in the experimental laboratory. We must follow farther the paths of Ollier and Macewen and Codivilla, and blaze trails beyond, bringing our clinical experience to bear upon the purely experimental investigations, seeking to interpret and better our results by knowledge of the fundamental physiologic processes, the laws of growth, and the minute mechanisms of repair.

We look forward with confident expectation to this development in the prevention of deformity and the restoration of function by exercise and bloodless methods; to a fuller appreciation of the value of rest in many diseases and many injuries; to a more com-

plete understanding of the mechanics of the human body and of the sound mechanical principles which must obtain in all the apparatus which we apply; to an increase in our knowledge of normal physiology and pathology; to the universal training of Orthopaedic Surgeons in surgical judgment and technique; to the recognition by great institutions and perhaps by our State and Federal governments that the segregated care of the handicapped under the direction of specially trained surgeons is not only a humanitarian measure, but of advantage to the body politic.

I thank you, gentlemen, for the honor you have done me in electing me your President.

DR. ARTHUR J. GILLETTE

Died March 23, 1921

BY DR. OSGOOD

It is my sad duty also to record the death on March 23, 1921, of Dr. Arthur J. Gillette, charter member of the American Orthopedic Association, its Second Vice President in 1892, member of the Membership Committee in 1893, and President in 1900; Professor of Orthopedic Surgery in the University of Minnesota, Surgeon in Chief to the Minnesota State Hospital for Crippled and Deformed Children, Orthopedic Surgeon to St. Joseph's, St. Luke's, St. Paul's, the Bethseda, and the City and County Hospitals of St. Paul.

To his energy and influence was due the establishment of the first state hospital in America for the care of crippled and deformed children. He remained until his death the inspiration of the model institution at Phalen Park. He was the pioneer orthopedic surgeon of the Northwest.

His domestic life was one of great happiness. He was a generous friend. The Association has lost a councillor who for many years helped to shape its policy, and by a full life devoted to the care of the cripple spread the gospel of the specialty.

DR. HARRY MITCHELL SHERMAN

Died May 15, 1921

BY DR. OSGOOD

On Sunday, May 15, 1921, Dr. Harry Mitchell Sherman, of San Francisco, died at the age of 67, from a cardiorenal complication of his old enemy, asthma.

Elected to the American Orthopaedic Association in 1889, he served as its Second Vice President in 1893, its First Vice President in 1896, and its President in 1899.

He was born in Providence, R. I. After receiving an A. B. from Trinity College and his M. D. from the College of Physicians and Surgeons, he became a member of the staff of the Bellevue Hospital and Assistant Surgeon at West Point Foundry, New York. Since 1886 he has been Orthopaedic Surgeon to the Children's Hospital and Surgeon to St. Luke's Hospital, and the University of California Hospital in San Francisco.

After many years of almost exclusive devotion to orthopaedic surgery, his work broadened into general surgery, and he was made a Fellow of the American Surgical Association.

He was the Nestor of Orthopaedic Surgery of the Pacific Coast. Of high scientific attainments, broad culture, great personal charm, and warmth of heart, he was the inspiration of younger men. Beloved by all who came in contact with him, unselfish in his devotion to his country, his profession, and his friends, his loss is widely felt, and with peculiar keenness.

FRACTURES OCCURING IN BONE GRAFTS.*

BY S. ALWYN SMITH, O. B. E., D. S. O., CH. M., F. R. C. S., EDIN.,
CARDIFF, WALES.

Fractures of grafts have occurred, I imagine, in the experience of most of us and I am bringing the subject before you so that we may discuss the causation, and determine if possible, as to whether the fault lies wholly, or in part with errors of operative procedure of after treatment, or of both.

Pre-war results of bone grafting in children and adolescents, and experimental work, largely on growing dogs, were so satisfactory that a too optimistic idea of the intensity of the osteogenetic power of the graft became prevalent.

I conclude that it is now generally accepted that an autogenous graft implanted into a bony gap, in the main, dies and is absorbed and replaced by osteoblasts derived to a certain extent from its own surface, but principally from the endosteum of the host bone at either end. This has been worked out experimentally by Gallie and Robertson and is to all intents and purposes the dictum propounded by Murphy, i. e., that a graft acts as a scaffold.

Given adequate coaptation and fixation between graft and host bone, circulation on the surface of the graft is apparently restored in a very few days after operation by means of granulation tissue and osteoblasts then proceed to absorb the base of the graft and to lay down new bone—this process beginning at each end of the graft in the region of the coapted surfaces.

As a rule, absorption outstrips restitution and as a consequence the graft becomes soft and porous at either end, particularly around each extremity of last bone. This occurs about the sixth week. If rigid immobilization of the part has not been carried out and stress or strain on the graft is allowed, the first and commonest type of graft fracture occurs, which we may call a "Disintegration Fracture."

This fracture generally happens six to eight weeks after operation and is more apt to occur if a graft of soft cancellous bone has been used. The use of ribs as grafts where any gap is

*Read at the meeting of the British Orthopaedic Association, London, Nov., 1920.

present is to court failure and for the same reason, slide inlays (where the bone is atrophic due to disuse) are not advisable if harder bone from elsewhere in the section is available.

Such a fracture may occur inside a well fitting plaster cast, if, on account of malposition of the bone fragments, the graft be put into position under stress. If strict immobilization continues after the fracture is discovered, union may occur, but if movement of the parts is permitted, disintegration of the graft goes on to an extent dependent on the porosity of the bone.

In a case of bone gap in the upper third of the ulna, that I operated on this year, it will be seen that on account of the deformity of the radius, there was a tendency to lateral bowing of the arm. At the operation I tried to keep this deformity in check as much as possible, although the graft had to be implanted somewhat obliquely to the long axis of the ulna.

The casts were carefully applied to prevent strain on the graft, but it bent at the upper end as soon as it became softened and a definite fissured fracture appeared at the maximum point of stress. At this stage there was a definite "give" in the graft on palpation. (Fortieth day.)

A further month in plaster enabled the graft to harden and now, eight months after operation, the fracture has united with a large amount of callus.

I may say that in these cases I fix the joints above and below the graft, but allow movement of the fingers from the beginning. The cast in this case gripped the wrist—like a short cock-up splint, to prevent pronation and supination. All protection was removed at the end of the fifteenth week.

The fracture then occurs above or at the end of the graft generally opposite or half an inch centrifugal to the extremity of the host bone.

When the fracture is complete, little further absorption appears to go on where the graft has a good matrix, such as one taken from the subcutaneous surface of the tibia. We have now a unilaterally fixed graft, which remains almost indefinitely devitalized, hard and sclerotic, while the site of fracture became a typical non union, the extremity of the graft becoming pegshaped. The portion of graft attached to the other end of the host bone, that is the sharp end appears to become reconstituted as this end

of the fracture becomes cup shaped. I show slides showing an old fractured graft of two years standing where the bone was found at reoperation to be hard and avascular with apparently no attempt at canalization although full function of the bone had been allowed for nearly two years. This point emphazises that where two bones are fractured after grafting such as radius or fibula, function of the limb is very different than function of the bone. Changes in bone follow Wolffs law only when function of the individual bone takes place. Another slide shows that the long end of a fractured graft of a years standing, when drilled, displayed no signs of circulation except for half an inch centrifugal to the extremity of the host bone.

Where a bone graft unites normally the graft remains hard and devitalised for a length of time proportionate to its length and width and original density, that is to say hard sclerous bone as from the crest of the tibia remains so longer than that from the subcutaneous surface which contains medulla. Conversely, as I have mentioned before, open mesh bone is prone to early fracture, but is reconstituted earlier. Should a graft survive the first three or four months without disintegration, we may regard the case as successful, although fractures after this time may occur. After this length of time, if the graft be given modified function restitution keeps pace with absorption, but the dual process slows down considerably and for a prolonged period the graft may depend almost entirely on its mineral constituents for its strength especially at its centre. The limb may appear strong but sudden strain or stress may produce the second type of graft fracture which, for want of a better name may be called "Clay Pipe Stem Fracture."

This generally occurs near the centre of the graft and is usually transverse, concave or convex, looking exactly like the broken ends of a Churchwarden pipe.

These fractures may occur several months after the bone grafting operation, especially where a hard cancellous graft has been used. Apparently, they will unite, but a prolonged period is required for a union to take place.

I show slides of two cases where this fracture occurred. The interesting point to note is that the graft in one is in the hip. A split spur of bone behaving as a graft, after having remained

dormant, so to speak, while there was no function, became osteogenetically active as soon as the limb was used; thus seeming to prove the infallibility of Wolff's law. In both instances I allowed modified function—that is locomotion in a calliper splint, one being a fracture of the femur and hip and the tibia. I inferred that stimulation of the fractured ends would increase the blood supply and consequently osteogenesis. To further this end each case was given percussion and damming as described by H. O. Thomas.

It has been shown experimentally by Gallie and Robertson, that boiled grafts will not stand the strain of bone gaps of more than three-quarters of an inch, although the physiological changes in such a graft are similar to those of autogenous grafts. I cannot see why suitable homogeneous grafts should not succeed and but a year ago, I decided to perform homogeneous grafting when the opportunity arose provided donor and recipient were sympathetic as regards their blood.

I was interested to see that Gallie mentions this point in his paper. I performed such an operation some weeks ago, but the short time that has elapsed is not sufficient to give you any data. The donor's blood was Group 4 and the recipient belonged to Group 2. The recipient was a case of ankylosis of the knee with a large ulcerating area on the heel that rest and various attempts at skin grafting had failed to cure. The recipient had a three-inch gap in the tibia. I used two big grafts—the homogeneous one I inlaid into the external surface of the tibia after retraction of the tibialis anticus muscle. I cut a good sized autogenous graft from the other tibia, which I inlaid into the subcutaneous surface of the tibia. The medullary aspect of each graft was in juxtaposition with the other. I thus hope to reconstruct a medullary cavity.

I think that disintegration of grafts is less common nowadays than formerly—it certainly is so in my experience and this I attribute to the present use of much thicker grafts than was formerly my custom, together with immobilization of the part for a longer period of time than was previously considered necessary. The thickness of the graft and its density prevents fracture during the time osteoporosis is going on, although final restitution and canalisation is so long a process that later fractures may occur when the bone is brittle and avascular.

Even after prolonged use, a successful graft remains distinct and the original site of nonunion appears sclerotic. I do not think that the question of operative fixation by means of metallic absorbable sutures or even where no sutures are used, has any bearing on the problem as long as adequate fixation and coaptation of surfaces is produced. Fractures have occurred with all methods. The question of coaptation is most important and it is necessary to have as much graft surface in contact with host endosteum as possible. This, by the way, is an important factor in skin grafting. The diagrams show how much more likely to succeed are abdominal flaps attached to the recipient arm area on three sides before the pedicle is cut, rather than long narrow "tip-over" flaps attached at each end.

The bone graft should be bulky and its consistency should vary with the length of the gap. The bigger the defect, the more compact should be the graft substance.

The cricket ball graft has one weak point—disintegration fracture is apt to occur at the junction between the wide and narrow portion as this is the slotting site. From the standpoint of technique, it is always easy to avoid weakening the junction by sawing into the neck of the graft, when making transverse saw cuts.

May I again labour the point of large coaptation surfaces and rigid immobilization in the early weeks after operation. These points are of supreme importance. I feel sure of obtaining uniform results and I fear that as rules of procedure, they have been too often observed in the breach with disheartening consequences.

Discussion

The President: This is a very interesting paper, and I know quite well that many men here have had a large experience of bone grafting, and a number of interesting questions have been raised, especially questions of scaffolding, absorption and fracture. I will ask Mr. Hey Groves to speak, as he did a great work in the war, and has taken bone grafting to a stage which is as near perfect as may be.

Mr. Hey Groves: Many interesting points have been raised in Mr. Alwyn Smith's paper, so that it is a difficult matter to confine one's remarks to a reasonable length.

First one or two words in criticism of his statements about the history and theory of bone-grafting. I do not think Murphy should be credited with being the first to initiate the idea of the bone graft as a scaffolding: it was originally the theory of Barth. His original drawings and sections demonstrate as clearly,

almost, as Gallie and Robertson in recent years, the process of vascularization of the dead bone. After Barth, all the painstaking work of Axhausen and others tended to reverse the opinion, and to show that the autogenous graft really took some active share in the regeneration of bone. Therefore I venture to protest a little against the assertion of Mr. Alwyn Smith, which seemed, rather, to imply that the graft only acted as a scaffolding, and died.

The subject is one of extreme complexity, and it will be many years before it is absolutely settled. It seems to me that many observations are necessary. What happens is, that in favourable cases an autogenous graft will take a very active share in the regeneration of bone. In unfavorable cases it will take no share, and the mere multiplying of instances where this latter occurs does not prove the point. It seems to me we should still take autogenous grafts in all circumstances where these are favourable.

In taking part in a debate in Canada last year with Gallie and Robertson school adherents, I put this to them: If, as they state, a patient is equally good with an autogenous graft, why do they consider themselves justified in taking a piece from the patient's own tibia? Obviously they do not believe what they themselves say, otherwise it would be easy to have pieces of bone ready to hand and they need not use the patient's own tibia.

The practical points raised by Mr. Alwyn Smith I am in agreement with. He has emphasised the great importance of using the grafts as large as the bone which they have to replace, if possible, because a certain stage of osteoporosis is gone through, during which the graft is very liable to fail.

With regard to the cricket-bail graft, his view is correct, and for some time now I have abandoned the simple way of putting in these grafts, i. e., putting one end in the fragment of the host bone, and levering out the end of the graft and slipping them together. It is a most attractive operation to do, and it is the best one to demonstrate to others; and, at the moment, it seems as near perfect as you can have it. But in a considerable number of cases, in my own practice and in the practice of those I have been associated with, there is a great strain on the point where the thick and thin portions of the cricket-ball graft join, and there is liable to be a fracture there. Therefore it is better to use the more difficult technique, driving one end of the graft into one host bone, leaving the other end much thicker, and tapering more, splitting the upper end of the host bone, and so putting it in, and surrounding the upper end of the host bone with some form of ligature.

Mr. P. J. Verrall: I was very interested in the remarks with regard to the humerus. I should say it is a part of the body in which you are especially apt to get trouble in regard to the graft. Recently I have had three successive cases sent on to me in which fracture has occurred in the graft. Two of them had very strongly positive Wassermann reactions; I think that is most important. I would like to have some information in regard to the Wasserman test in all the cases which have been recorded. In the case of the humerus I have given up using any form of lateral inlay graft at all. There are, I think, only two ways of doing the humerus; either to get the two ends absolutely square and in contact—in which case one fixes them with a double intra-medullary peg; or where there is a gap I have adopted one course only, namely, a double intra-medullary fibula; then there is a continuous medulla from end to end. I have done four cases now, and all with success. I have two coming tomorrow to show you. The fibula thickens up. I ask for guidance as to the subsequent treatment of fibula grafts, that is, as to when one should trust the bone. I have let them go with abduction plaster for three or four months, and then put on a plaster allowing movement, at the shoulder, not at the elbow. It is rather pioneer, in a way, to know when one should let free use of the arm thicken the bone.

(In answer to Mr. Hey Groves): By a double intramedullary graft I mean one graft, intramedullary at both ends.

MISS FORRESTER-BROWN: The upper end of the ulna seems particularly difficult to get to unite, and I think that must have some relation to the position of the nutrient artery. Unless there is much overlapping of your graft on the ulna, there is apt to be a false joint at the upper end. The lower end of the humerus seems somewhat the same. In Mr. Alwyn Smith's case there was displacement of the upper fragment of the tibia. Even in the case of an intramedullary graft the upper fragment seems to deviate towards the radius and it forms an angle with the graft.

MR. A. H. TUBBY: Some of the most difficult cases of bone-grafting we have had to deal with, have been those of gunshot fracture of the jaw, followed by an un-united fracture. The difficulty in securing a good result here after bone-grafting, is due to septic infection arising from contact with the secretions of the mouth at the site of the operation. Before the operation, the wound of the oral mucous membrane must have healed, and during the operation you must take great care not to penetrate into the mouth. I think you will find the jaw shows a ready tendency towards union after bone-grafting, if these precautions are observed. After a gunshot wound of the lower jaw in a young soldier there was non-union and a gap of one inch. It was necessary to graft bone. In exposing and refreshing the ends of the fragments, minute care was taken not to wound the mucous membrane covering the gums and bone. Being satisfied on this point, a graft was taken from the tibia and placed in position. Firm bony union occurred in four weeks, and the man went home in a satisfactory state. With the precautions, which have been referred to, bone-grafting in these cases, should not be regarded with so much apprehension as it has hitherto been.

MR. HEY GROVES: Miss Brown spoke about the ulna, and I think her point was an important one. May I suggest a valuable technique in dealing with the ulna? It is to bore the proximal end of the ulna, and then the distal end, then cut a peg from the tibia, roughly shaped to be about $^3/_8$-inch thick, and this is driven down like a nail, the proximal end of the ulnar fragment being exposed by splitting the triceps tendon, and the graft being nailed down. This gives extraordinarily firm fixation to both the proximal and distal fragments, and I think it is a decided advance over any other method.

MR. ALWYN SMITH (in reply): I think the question of blood supply in these cases is very important, and I always understood that the results of bone-grafting of the jaw were universally satisfactory on account of the fine blood supply there is to the part. And I always regard the junction of the lower and middle thirds of the tibia as a danger spot, because there the circulation is apt to be poor and as a consequence there may be a paucity of osteoblasts. The ulna at about the junction of the upper quarter and the middle half has been the point I have had trouble with. At a point three or four inches below the elbow joint, where you can get the upper end into the bleeding cancellous part of the olecranon, I have had very good results. Where there is displacement in the bones, such as I showed in the case of the ulna, where the radius had united after a long time, but with bowing, there I do not think it is well to put in a graft under stress so the graft is really not ossially correct. I put my graft in so that it lies parallel to the long axis of the bone. I use simple soft iron wire, which one can get from the ironmonger very cheaply. You can make sure at the end that you have absolute co-aptation of the surfaces. I have had very little trouble with my non-absorbable suture material, and I do not want to go back to pegging them in or using catgut or kangaroo tendon. I like to see that it is a mechanical as well as a surgical job by the time I have finished. Seeing that the graft is well and truly fixed in has much to do with getting the circulation well established.

THE POSSIBILITIES OF SUTURE AFTER EXTENSIVE NERVE INJURY*

BY MAUD FORRESTER BROWN, M. D., B. S BANGOUR.

If you find me going over ground which is familiar to all of you, you must excuse me, but I have been led to select this subject by finding few references to it in a large amount of recent literature on the subject of Peripheral nerve injuries. Moreover, I was struck by the number of cases reported, in which the surgeon had regarded gaps of 2″ or 3″ in the nerve as hopeless for suture and had resorted to nerve-grafting.

At Bangour nearly all the nerve graft operations were done in the early days of our experience and it seems likely that a big proportion of them could have been sutured with our present technique.

Out of 500 consecutive cases operated on between 1916 and 1918, suture was not able to be carried out in 31 (6.2%). Of these 7 involved the Musculo-spiral and 3 the External Popliteal and these were subsequently treated by tendon-transplantation. Another 10 were abandoned without attempt to bridge the gap. 11 were treated as nerve-grafts and of these only 3 have shown any definite evidence of recovery, which was not complete when they were last examined.

As all observers seem now agreed that the prognosis is bad after nerve-grafts, it is most important to get end-to-end suture of the nerve if possible. I propose, therefore to run over quickly the methods at our disposal for relaxing the nerve so as to get apposition of the cut ends, and then I will tell you what our experience at Bangour has been as to the possibilities with the various nerves.

The methods available then are in number namely:

1. Extensive *freeing* of the nerve from its bed.
2. Relaxing it by fixing *joints* in suitable positions.
3. *Altering the course* of the nerve.
4. *Stripping* up any *branches* which anchor it.

*Read at the meeting of the British Orthopaedic Associtiou at Edinburgh, June 4th, 1920.

5. *Sacrificing branches.* (Compensating for Motor branches by tendon-transplants.)

6. Shortening *bones.*

7. Stretching the nerve in *two stages* by two successive operations.

1. The first step is then to *free the nerve* from its fascial connections, so as to take advantage of its inherent elasticity. The greater the length we free the greater is the gain. There is probably a limit, which is constant for each nerve, though it may vary with the individual patient. The elasticity is much reduced by sepsis which had spread up the sheath or nerve bundles. By this method in the *Median* or *Ulnar* in *Arm* we can gain 1½″; in the forearm 1″; in the *Sciatic* in *Thigh* 2″.

2. The next method is to relax the nerve by *fixing* the *joints* in suitable positions. As the main nerves of a limb pass across one or more joints and are of such length normally that they are barely taut in the position of maximum strain, it follows that considerable gaps in a nerve can be dealt with by fixing the joint for a time in the position which relaxes the nerve, and gradually stretching it later. To take full advantage of this manoeuvre, it is necessary to *free* the nerve *extensively* first; otherwise its fascial connections compel it to follow the curves of the limb instead of stretching like a bow-string across the concavity of the joint. It might be feared that this device would *permanently limit* the *range* of the joint, a serious complication; but experience shows that such tense nerves *yield well* to gentle and gradual stretching. For fear of rupture at the suture line, it has been our custom not to begin any stretching for *six weeks* from the date of operation. I have not met a case in which the full range was not obtained; usually this is within 2 months, but occasionally 3 to 6 months are required to fully stretch the nerve. As no considerable degree of recovery can be expected under that period, and as massage is advisable in any case, the joint condition does not represent a serious disability.

Adduction of the *arm* at the shoulder gives about 1″ (beyond that gained by freeing) to the Median, Ulnar, Musculo-spiral and Musculo-cutaneous.

Flexion of the *elbow* gives about 2″ to the Median and 1″ to the Musculo-spiral, as the latter courses to the back of the forearm immediately after crossing the elbow.

Extension of the *elbow* relaxes the Ulnar, giving about 1″. The Median and Ulnar are therefore antagonistic to one another. Fortunately it is easy to bring the Ulnar to the front of the elbow and so relax it with the Median.

Flexion of the *wrist* gives about 1½″ to the Median and Ulnar in the forearm.

Flexion of the *knee* gives about 2″ to Sciatic, or Popliteals, in addition to the 2″ gained by freeing alone.

3. *Alteration* of the *course* of a nerve.

I have referred above to the possibility of altering the course of the Ulnar so as to gain the advantage of flexion of the elbow which relaxes the nerve 2″ to 3″ compared to the 1″ gained by *extending* it with the nerve in its normal bed. The *Ulnar* is the nerve which gains most by an alteration of its course, as its normal one is so *devious* from the front of the arm to the back of the Int. condyle and then forward again to the front of the forearm. The nearer the mid line it is brought, the shorter is its course; it is hindered from reaching the mid line by the *branches* to Flex. Carpi Ulnaris and Profundus, which arise from it behind the condyle and enter the muscles after a short course; they can however be freed up from the main nerve for some distance and then allow it to be displaced further.

Another nerve which sometimes benefits by *transposition* to the front of the limb is the *Musculo-spiral.* Lesions of this nerve are often complicated by fracture of the humerus, and if the bone has united with *backward bowing* and *excess* of *callus* behind, the course of the nerve may be shortened 1″ or more by bringing it to the front of the humerus between the Biceps and Brachialis Anticus. As the upper end of the Musculo-spiral is best found in extensive lesions, by an *incision in the axilla* along the inner border of the Biceps, transposition only entails lengthening this incision.

The only other nerves whose courses we have attempted to alter are the *Median* and *Posterior Tibial*, by bringing the former superficial to the *Pronator Radii Teres,* and the latter superficial to the *Soleus*, so as to gain the full benefit of flexion of the corresponding joints, instead of letting the nerve be held at an angle by the muscle.

4. *Stripping-up* of *branches.*

After the 3 methods referred to so far have been tried, it often happens that a gap still remains between the nerve ends, which are *anchored by* the origin of *branches*, while there is obvious *slack* in the nerve *beyond* these branches. We have therefore at Bangour resorted to very extensive stripping up of branches from the main nerve in difficult cases and thus have got apposition of nerve-ends which at first seemed hopelessly separated. We have found that this procedure does *not impair the function* of the branches except for a few days.

The maximum gain is obtained when the *branches* arise *above the lesion*, so that the part of the nerve from which they originally arose can be pulled down to the level of their entrance into the muscles and even far beyond this so that they run an *inverted course*.

There are *certain groups* of nerve branches to which this treatment is specially applicable, in that they run an independent course within the main nerve sheath for a considerable distance, and therefore their apparent origin from the nerve is not their real one. Such are:

a. The *Triceps* branches of the MUSCULO-SPIRAL, which appearing to come off singly in the Musculo-spiral groove, can be traced to one leash which can be stripped from the main nerve as high as the apex of the axilla.

b. The *Motor* branches of the *Median* for all the forearm muscles come off in one leash under cover of the Pronator Radii Teres and divide into two sets, one to the superficial flexors, the other to the deep flexors including the Anterior Interosseus; the whole leash can be stripped from the Median to 1″ above the elbow while the branches to the Pronator which arise above them can be stripped even higher.

c. On the *Ulnar*, the branches to the *Flex. Carpi Uln.* and *Profundus*, as already mentioned can be stripped to above the elbow.

d. The *Hamstring nerve* sometimes arises independently of the SCIATIC, but often leaves the main nerve as a series of branches all down the thigh; yet it can always be freed up to the notch.

e. The branches to the *Gastrocnemii* from the Int. Popliteal can be freed to the upper end of Popliteal space.

f. *All* the branches of the *Posterior Tibial* can be stripped up for considerable distances.

The two nerves which do *not* lend themselves to this treatment are the *External Popliteal* and *Posterior Interosseus*, for they divide near their origin into several branches of nearly equal size, which are usually all involved in the lesion.

I will give you short reports of two cases to illustrate the fact that such extensive disturbance of branches need not paralyse them and that the extreme tension on the nerve does not prevent recovery.

1. Cpl. Dalby G. S. W. R. forearm 31=8=18. Healed October 1918.

Cond. 11=3=19 Median anaesthesia and paralysis of small muscles. Tendons adherent. Partial Ulnar anaesthesia and weakness of small muscles.

Op. 12=3=19 Suture of Median in forearm—4″ gap. wh. overcome by mobolising Pronator and freeing nerve fr. lower one-third of arm to wrist and pulling proximal end down till its leash of motor branches were inverted, joints flexed. Ulnar freed and tendons; Flex. c. Rad. sutured in spite of loss of its mid 1/3.

Sixth week—Progress 6=9=19 thenar hyperalgesia. 21=9=19 pressure now felt on Median area. 11=10=19 prick and wool felt exc. for small patches. Abd. Poll. responds to Faradism.

Nine weeks after operation—21=12=19 Thenar muscles act well. Only disability adhesions of flexors of index. Hand otherwise very good.

2. Pte. Owens bullet wd. L. forearm, fractured Ulna 14=7=18. Healed 25=2=19.

Cond. February 1919 Ulnar anaesthesia and paralysis. Knuckles stiff to flexion. Extension of elbow and wrist limited.

Op. 29=3=19 suture of Ulnar after transposition into groove in flexors. 3¾″ gap. Ulnar freed fr. wrist to lower 1/3 arm; branches to Flex. C. Ulnar and Profundus freed to allow nerve to reach front of elbow; course inverted. Elbow and wrist acutely flexed. Inner 2 Prof. tendons wh. cut, sutured to rest of profundus. Faradic response obtained in Flex. C. Uln., branch arising above the lesion.

Eight weeks—Progress 20=5=19 Flex. C. Uln. acting well; inner profundus weak. 6=6=19 Hypothenar tenderness; joint sense returned in 2 prox. jts. of little finger. 4=1=19 wrist str. with elbow at rt. angle. 24=7=19 wrist can be dorsifiexed. 22=8=19 pressure felt in little finger. 4=9=19 prick and wool felt on some parts. Abductor Min. Dig. just contracts.

Six and one-half weeks—3=10=19 wrist free and elbow as much as before op. 9=10=19 transplant of Palm. Long. to Ext. Commun. 2=11=19 sensation completely returned. Abd. Min. Dig. gd.

Ten and one-half weeks—4=2=20 Interossei begin to act.

5. If we still fail to get apposition after the devices referred to already, we must consider the advisability of *sacrificing branches.*

I mentioned before that the stripping up of branches only gives much relaxation of the nerve if the branches arise above the lesion; those *below* it have a fixed insertion and soon become tense themselves. We must remember that these are *already paralysed* and therefore suffer nothing in the attempt to suture another part of the nerve by dividing them.

Branches above the lesion should be sacrificed, if the function of the rest of the nerve surpasses theirs in *importance.* Thus the *Ulnar* motor and sensory supply *to the hand* is far more valuable than that to the Flexor Carpi Ulnaris, or even the inner 2 Profundus tendons, which can moreover be got to function by suturing them *to the outer two,* which are innervated by the Median.

Sir Harold Stiles pointed out to us that the *sensory* portion of the *Median* far *surpasses* in importance its whole Motor portion, since if the thumb and index finger remain anaesthetic, the patient does not use them, even when the muscles are acting. If only the Median muscles are paralysed, the *Ulnar muscles* give the digits quite *useful function,* which can moreover be supplemented by tendon-transplants.

It is only necessary to *sacrifice* the *Median* motor branches in the forearm for gaps of *more than 4".* In this way a *6½" gap* has been overcome. It must be remembered too, that such extensive lesions of the nerve are almost invariably accompanied by

destruction of some of these *branches*, or of the *muscles* that they should supply.

6. One other method of relaxing a nerve remains after these mentioned have been used, namely to SHORTEN THE BONES of the limb.

We have found this very useful where an *ununited fracture* was already present. This is most commonly a fracture of the *humerus* associated with a *Musculo-spiral* lesion. In such cases it is easy to expose the nerve-ends, note the amount of relaxation required, and then unite the bone by *stepping it* with the requisite shortening.

In the forearm where an *ununited radius* complicates the nerve injury and where there is extensive scarring, a good result is attained by *shortening* the *Ulna*, suturing the nerve, and later grafting the Radius, as illustrated by the following case.

Pte. Ness G. S. W. L. fractured Radius 22=8=17. Healed 23=3=18. Ununited Radius; pronation deformity; contracture of elbow, wrist, thumb. Flexor tendons adherent; fingers stiff and straight. Median divided. Trophic changes marked.

First Op. 29=3=18 1½″ removed from Ulna subperiosteally; intramedullary peg. Plaster in pronation; changed to supination in 7 weeks. 13=5=18.

Second Op. 15=7=18 Median sutured in mid forearm after resection of neuroma, 1″ gap, nerve slack, though muscles already shortened up, wrist put straight. 4=9=19 Tingling 2″ below suture; thenar tenderness; trophic improvement.

Third Op. 19=9=19 Radius freshened, ends drilled and tied with kangaroo tendon; sliding graft, small.

Aug. 1919 Sensation quite returned; Opponens acting; fingers flex well; Radius united.

We have *hesitated* to divide *both bones* of the forearm where these were undamaged or already united, because there is always the risk of a *flare-up* of the initial infection, which might cause *non-union*, while any *excess of callus* would limit *rotation* of the forearm. Double forearm fractures are notoriously difficult to control, and any failure converts an already serious disability into a *disaster*.

7. When all the methods we have already discussed fail, there is still one way which may enable us to attain end-to-end

suture ultimately, namely a *two-stage* operation. In the *first* stage, the *untrimmed* nerve ends are *anchored* together with strong thread while the joints are flexed. *Extension* of the joints is begun *early* before the nerve has time to form adhesions, and as soon as it is fully stretched, it is *explored again,* the joints are again flexed and the relaxation so obtained usually allows for suture *after resection* of the neuromata. This is an operation which can be recommended when *sepsis* is unexpectedly encountered during a nerve exploration. The following cases illustrate its application:

1. Pte. Herdman G. S. W. L. fractured Ulna 10=8=18. 30=1=19 unhealed; Ulna ununited; Ulnar completely divided.

30=1=19 first operation, unhealed scar excised; adherent bone excised; Ulnar neuroma anchored to distal end without opening up healthy tissues but with wrist flexed.

24=2=19 thread came away, but nerve held.

2=4=19 healed.

4=8=19 second operation, Ulnar sutured after resection of 1½″, freed up forearm; wrist flexed and elbow kept straight.

21=7=19 sensation to deep pressure returned.

4=6=19 joints free.

31=1=20 sensation returned on ring finger and prick felt on palm. Abd. M. D. acts Ulna ununited but no disability from it. Hand useful. The total gap in this case is equivalent to 3″, the limit which can be dealt with without transformation.

2. Pte. McKenzie. G. S. W. R. fractured humerus 24=10=18.

25=10=18 Musculo-spiral sutured with catgut at C. C. S. (Post. wd. sutured). Healed 28=2=19, after which heavy massage given.

First operation 2=4=19 Musculo-spiral neuroma anchored to distal end with catgut (¾″ overlap). Nerve destroyed in whole groove (about 3″). Neuroma lay with sequestrum in abscess in humerus. Nerve transposed and elbow flexed to 90°. Progress 21=4=19 pus burst through old posterior scar. 4=7=19 firmly healed. More heavy massage.

Four weeks 26=8=19 elbow range 90° to 160° (limited by arthritis as before operation).

Second operation 6=10=19 Musculo-spiral sutured with arm adducted to 45°. 1″ gap after trimming till good fibres reached. Distal end was indurated and inelastic. Primary healing.

16=1=20 tenderness of carpal extensors. Tingling to middle of forearm.

Six weeks 16=4=20 full abduction of arm. Ext. Carpi Rad. acting.

3. Pte. Martin. G. S. W. R. axilla 27=8=18. Oct. 1918 Brachial doubly ligatured for false aneurysm. Healed Nov. 1918.

Cond. Jan. 1920, complete Median paralysis and anaesthesia. Partial Ulnar ditto. Much stiffness, atrophy and trophic changes.

First operation 26=1=20 ends of Median anchored together without trimming. 4″ gap. Proximal end had 2″ neuroma; distal end ran in scar down to elbow. Elbow at 90°, arm to side of chest. Ulnar freed throughout arm.

Two weeks 9=2=20 stretching begun. Arm abducts to 60°.

29=2=20 arm to 90°; elbow to 100°.

Two and one-half weeks 1=4=20 full range of joints.

Second operation 8=4=20 Median sutured after trimming 1¾″ which left vascular fibres though swollen in proximal end and degenerate in distal one, wh. inelastic. Prox. end not normal to apex of axilla. Arm adducted; elbow to 80°. Primary healing. Though thread of first operation found surrounded by pus which was negative on culture.

To sum up:

The gaps in peripheral nerves which allow of end-to-end suture.

ARM	MEDIAN	ULNAR	MUSCULO-SPIRAL
By Freeing widely	1½″	1½″	1″
Adduction at shoulder	1″	1″	1″
Elbow flexion	2″	Extension 1″	1″
Transposition and elbow flexion	....	1½″ more	½-1″
TOTAL	4½″	5″	3½-4″

FOREARM	MEDIAN	ULNAR	Remarks
Freeing widely	1″	1″	Less than in arm
Elbow	Flexion 1½″	Extension 1″	as so many
Wrist, flexion	1″	1″	branches
Inverting branches	1″	1½″	fix them.
Transposition and elbow flexion		2″ more	Median has more branches than
TOTAL	4½″	5½″	Ulnar
SACRIFICING BRANCHES	2″ more	1″ more	
TOTAL	6½″	6½″	

TWO-STAGE OPERATION (anchoring neuromata) gives 2"-3" more in the end.

SCIATIC (any level from notch to knee)

Extensive Freeing	2"
Flexion of knee	2"
TOTAL	4"

POSTERIOR TIBIAL below middle of leg i. e. below main branches:

Freeing (including Sciatic)	1 "
Knee flexion	2 "
Inverting branches	2½"
Ankle plantar-flexion	½"
TOTAL	6 "

N. B. With more extensive destruction of the nerve than can be dealt with by the above methods there is almost sure to be such wide spread injury to other soft parts, if not to the bone, as to render the limb of little value, even if the nerve were to recover, so that its involvement becomes of minor consideration.

After all these devices have been resorted to, we shall still encounter a few cases in which end-to-end suture is impossible. Fortunately the *Motor* function of most of the nerves of the upper limb can be substituted by *tendon transplants.* Indeed that for Musculo-spiral paralysis gives an almost normal hand within a few months, and this nerve is the one most likely to prove inoperable.

Loss of all the Sciatic muscles does not always give a great disability.

If either the *Ulnar or Median* muscles are functioning, they *substitute* so well for each other that the patient may not greatly miss the one.

It is the *Sensory function* of the Median and the *Trophic* function of both Median and Internal Popliteal that represent such a serious loss, and therefore *nerve-grafting* is worth trying as a last resort, for it can do no harm. Out of the *11 cases* operated upon in this hospital, most have shown the signs of commencing nerve regeneration and *two* have definite Motor and Sensory return, though incomplete when last seen.

Discussion

Mr. Platt: I have listened with great interest to Miss Forrester-Brown's paper, but I am not quite convinced that her recoveries are quite genuine. I believe that everybody will be tricked some time or other, in fact, after six years examining nerve Injuries, I have come to the conclusion that most people are unable to tell whether a nerve has recovered without cutting down and stimulating. It is an exceedingly difficult thing to be sure of recovery in some of these nerve injuries, and the more one sees of these cases the less sure one becomes. I believe the only proof In these cases is to re-explore and see what happens when stimulation is applied.

With regard to the general question of closing these enormous gaps, personally, since I have been making a wide exposure of nerve at operations, I have not met with a case since 1917, where I was not able to close completely, and that I believe to be the experience of most men. In this connection I agree with Miss Forrester-Brown that it is justifiable to sacrifice the proximal supply.

I am sorry if I have appeared to be skeptical about Miss Forrester-Brown's two cases.

Mr. Leaming Evans: I transplanted an external popliteal from an amputated leg, two years ago, and there were certain appearances of a recovery, but they were fakes. I was influenced to cut down and look at the transplant, and this I did, and I could not find the median nerve, I could not find the transplant: it had apparently absorbed.

Mr. Bankart: In my opinion, if a man can do what he wants to do, it does not matter whether it is a trick or not. It is a matter of re-education, and the question is whether the same result can be obtained by re-education as by ransplants.

*Murray S. Danforth: Dr. Forrester Brown has given a very valuable and helpful paper based on a great amount of work, well done and well studied. It will be of great assistance to the surgeon doing nerve repair work to know approximately how much can be resected and still allow of end to end suture, for grafting to fill a gap has not been shown to give much hope of recovery.

Dr. Forrester Brown's paper is of further practical value for it not only states how much of a gap can be filled but outlines very clearly the methods to be employed. One method which is called to our attention and may prove of considerable help is the stripping up of the branches to allow of greater mobility of the nerve. That this stripping up is mechanically possible is well known but Dr. Forrester Brown's analysis of the cases in which this was done shows that the physiological continuity of the nerve is not destroyed or even impaired more than temporarily. The suggestions as to the possibility of destruction even of motor branches where by so doing nerve repair can be made which will restore sensation are also worthy of attention, as one makes use of this method only where the motor function is of far less value than the sensory function, or where the motor function can be restored by tendon transplantation.

It is by such careful analyses of cases, well done and well studied, that it is possible to actually advance the knowledge of nerve repair, and the series of cases reported adds to the sum of our knowledge.

*Written by Dr. Danforth in the U. S. as comments upon the above paper.

Editorial

THE AMERICAN ORTHOPEDIC ASSOCIATION

Boston Meeting, June 2-6, 1921

The 1921 Meeting of the American Orthopedic Association was the largest and in many respects the most important in the history of the Association. Sir Robert Jones and Professor Putti were both so good as to say that it was the best Orthopaedic Meeting they had ever attended. So much of the merit of the meeting and so much of the pleasure of the members and guests were due to the efforts of Dr. and Mrs. Osgood, and the members of the Boston Committees, that the Editor takes pleasure in submitting the entire list herewith:

President—Dr. Robert B. Osgood.

Programme Committee—Dr. William E. Gallie, Dr. James W. Sever, Dr. Lloyd T. Brown.

Local Committees—Dr. Robert W. Lovett, Chairman, Committee of Arrangements.

Ladies' Committee—Mrs. R. B. Osgood, Mrs. Robert Soutter, Mrs. Z. B. Adams, Mrs. J. W. Sever, Mrs. M. H. Rogers, Mrs. L. T. Brown, Mrs. L. T. Swain.

Press Committee—Dr. E. H. Bradford, Dr. Frank R. Ober.

Printing—Dr. Charles F. Painter, Dr. Mark H. Rogers.

Meeting Places—Dr. Robert Soutter, Dr. Frank R. Ober.

Trains and Train Reservations—Dr. E. G. Brackett, Dr. Henry Fitzsimmons, Dr. Andrew MacAusland, Dr. Marius N. Smith-Petersen.

Hotels and Housing—Dr. Joel E. Goldthwait, Dr. Loring T. Swaim, Dr. John Morton.

Automobiles and Transportation—Dr. Z. B. Adams, Dr. L. A. O. Goddu, Dr. P. D. Wilson.

Luncheons and Dinner—Dr. Augustus Thorndike, Dr. John Dane.

Acknowledgement must at once be made of our debt to our foreign guests, Sir Robert Jones, Professor Jacques Calve, Professor Vittorio Putti, and Mr. Harry Platt. They not only attended and added interest to all of our sessions but contributed formal papers of the greatest interest and scientific value. Sir Robert Jones influenced the entire meeting by his great knowledge of orthopaedic surgery and inspired every member and guest by his extraordinary energy and enthusiasm. Professor Calve described several new and interesting diagnostic and surgical procedures in scoliotic and tuberculous spine conditions. For our convenience he presented his contributions in English.

Professor Putti because of the highly scientific character of his papers on knee joint surgery and by his charming personality quite won the entire Association. Mr. Platt's paper on peripheral nerve surgery was also one of the most important papers read at the meeting.

At the sessions, which were held in the Boston Medical Library, it was not unusual to have more than 200 (an unprecedented number) in attendance. Unusual interest was manifested in the address of the President—historical in character—and in the paper by Dr. Allison on "The Teaching of Orthopaedic Surgery."

One of the interesting conclusions of the meeting was the general feeling as to the value of the "Commission" studies and reports. Previous commission activities on infantile paralysis and scoliosis had already produced interesting and instructive results. At this meeting the reports of the "Congenital Hip Commission" by Drs. Goldthwait, Z. B. Adams and DeForrest Willard, the "Commission on Ankylosing operations on the spine" by Drs. Brackett, Rugh and Baer and the "Commission on Foot Stabilizing operations in infantile paralysis," by Drs. Cook and Stern were received with the closest attention and unmistakable approbation. It was distinctly the feeling of those who heard the reports that the Commission Study of these problems was leading us to more definite ideas as to the value of methods in vogue and to standardization of the best surgical and other therapeutic procedures.

Dr. Ridlon's paper on the treatment of "Congenital dislocation of the Hip" will stand as one of the valuable documents of the Association and in fact of the history of the subject.

Other papers which attracted attention were those of Dr.

Lovett and Dr. Gill on "Infantile Paralysis," Dr. Bennett on "Quadriceps tendon lengthening," Dr. Starr on "Tendon Surgery in Military Hospitals," Dr. Steindler on "Arm and Shoulder Disabilities," Dr. Hoke on "The Stabilization of paralytic feet;" and Drs. Gallie and LeMeseurier on "Free fascia transplants." Saturday afternoon was spent at the interesting school for cripples at Canton.

At the dinner on Friday evening the members and guests were not only delightfully entertained but edified and instructed as well. At Dr. Osgood's request Dr. Bradford introduced the speakers. Sir Robert Jones spoke in the warmest terms of his friendship for American orthopaedic surgeons and of his enjoyment of the meeting. Professor Putti, Professor Calve and Mr. Platt spoke in similar vein.

Dr. Wilfred Grenfell, with lantern slides, told the members of his interesting and helpful work in Labrador. Dr. Grenfell was a frequent visitor at the formal sessions also. Mr. Adair of Atlanta and Mr. Kendrick of Philadelphia outlined the work so far and the plans of the Nobles of the Mystic Shrine for the care of crippled children. Their remarks were received with much enthusiasm. Dr. Allison, president elect, and Dr. Osgood the retiring president were the concluding speakers.

Following the three day session June 2-4, the members of the Association were given a delightful holiday on Sunday, June 5th as guests of Dr. and Mrs. Osgood at Ipswich. A clam and lobster dinner was served on the beach near Dr. Osgood's summer cottage, in the lovely estate of Mr. Crane of Chicago. Delightful weather made it possible for all members of the Association and the ladies to enjoy fully an occasion which will always be a cherished memory.

On Monday the Clinical Day was marked by Diagnostic clinics and operations upon the cadaver by Sir Robert Jones, Professor Putti, and Professor Calve. Dr. Smith Peterson showed the technique of his method for arthrodesing the sacro iliac joint. Dr. Osgood's dissections of the painful elbow bursa were shown and cured cases reported. Dr. W. R. MacAusland showed a convincing film of the operation and cases—of his method of elbow arthroplasty. Dr. Lovett presented a most interesting series of x-ray studies of bone conditions. These had been diagnosed by conclusive laboratory methods as syphilis, tuberculosis, osteomyelitis and sarcoma.

It was found that they did not at all conform to existing conventional ideas as to the possibility of arriving at a diagnosis by x-ray. Dr. Legg presented further studies and later views as to Legg-Calve disease. Professor M. J. Rosenau discussed bovine tuberculosis.

All of the matters above referred to and others will, in due course be published in further detail in our Journal. The meeting was one which it was a privilege to have attended and certainly a matter for regret to have missed. Orthopaedic Surgery and those who attended the meeting are better for it. As decided by a final vote at Boston—many thanks to those who made it possible.

Dr. Nathaniel Allison of St. Louis is president for the coming year. New officers elected were, Dr. Ralph R. Fitch of Rochester, New York, president elect. Dr. W. S. Baer, Baltimore, Vice president, and Dr. DeForest Willard, Philadelphia, Secretary.

AMERICAN MEDICAL ASSOCIATION, ORTHOPAEDIC SECTION

Boston, June 7-10, 1921

The Orthopaedic section of the American Medical Association was more largely attended than at any previous meeting. Dr. M. S. Henderson of Rochester, Minnesota, was chairman, and Dr. H. B. Thomas of Chicago, secretary. An excellent program had been arranged. Only a few of those who were listed to read papers failed to appear. The foreign guests of the American Orthopaedic Association remained for this meeting also. They attended the sessions faithfully and contributed greatly to the discussions. Sir Robert Jones especially contributed many valuable points from his experience to the discussion on Fracture of the Neck of the Femur; Elbow Injuries, et cetera.

The meetings took place in Paul Revere Hall, Mechanics Building, which was commodious and conveniently located. Unfortunately it was poorly ventilated and at times rather noisy. Notwithstanding these handicaps, there was an attendance of from one hundred to two hundred and fifty at the various sessions. The registration for the section was above one hundred and fifty.

For his chairman's address, Doctor Henderson gave a summary of and his conclusions from the bone graft work done at the Mayo Clinic. 413 cases had been studied and final results were reported. Doctor Henderson's conclusions were that the autogenous inlay bone graft done under proper conditions was our best method of treatment for most cases of non union in fractures.

Professor Putti and Professor Calve both presented original communications which were well received. Professor Calve's report of plaster and splint methods in high dorsal scoliosis was of especial interest. The symposium on Fractures of the hip to which Dr. Ruth, Dr. Royal Whitman, and Dr. Ridlon contributed, was thoroughly discussed and constituted one of the most important parts of the program. Dr. S. Fosdick Jones of Denver read an especially interesting report of a case of Garre's osteomyelitis. Dr. Kurlander of Cleveland added to his previous contributions on Injuries to the Spine of the Tibia. Sir Robert Jones' remarks upon this paper were also of especial interest. Dr. Steindler of Iowa City gave an especially interesting report upon the results of occupational therapy. Steindler had worked out for arm and shoulder conditions and showed by graphic charts exactly the effects and periods of usefulness of various kinds of employment therapy. The new officers elected were as follows:

Chairman—Dr. H. Winnett Orr, Lincoln, Nebraska.

Vice Chairman—Dr. Willis Campbell, Memphis, Tennessee.

Secretary—Dr. H. B. Thomas, Chicago.

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Current Orthopaedic Literature

TWO UNUSUAL NERVE LESIONS. By Alexander Gibson, M. A., M. B., Ch. B., F. R. C. S. (Eng.), F. R. S. E., Winnipeg, Manitoba. *Surgery, Gynecology and Obstetrics* December, 1920.

In this article two case histories are detailed, one military, the other civilian, to illustrate the importance of precise anatomical knowledge in dealing with nerve surgery.

The first case showed twitching of the muscles of the right side of the face, accompanied by cutaneous hyperaesthesia and a tendency to lacrimation.

The symptoms were due to scar tissue involving: (1) twigs from the infraorbital branch of the maxillary division of the trigeminal, and (2) the buccinator branch of the mandibular division of the same nerve. The irritation of this scar tissue produced heightened irritability of the motor and secretory nerves corresponding.

The second case occurred in a butcher who presented atrophy of the left interossei but no sensory disturbance and no atrophy of the hypothenar eminence. The condition in this case was a pressure neuritis due to grasping the hide in skinning the animal. A tender spot was present in the palm of the hand corresponding to the point of maximum pressure. As far as can be made out this is a somewhat rare example of an industrial malady.—*A. Gibson.*

CYTOLOGIC INVESTIGATION OF TUBERCULOUS JOINT EFFUSION. By Walter Pewny. Wien. kl. Woch. 1921 No. 3, page 23.

In arthritis with effusion it is occasionally difficult to differentiate between a tuberculous and other processes. The author has therefor made cytological examinations of exudates from knees to throw more light on the differential diagnosis.

In tuberculous arthritis without involvement of bone he found in the exudate between 2000 to 3000 leucocytes. The relation between leucocytes and lymphocytes has been 70:30. The absolute number of lymphocytes was around 1000. In case with mild bone involvement the white cells grew to 10,000 to 20,000, while marked bone infection raised the numbers to 400,000. The albumin contents of the exudate varied in different conditions: in exudate from simple synovitis of the knee he found 30 to 40 per mill., in that from joints with hypertrophic changes 50 per mill. while in a purulent effusion of knee 80 per mill. The lowest figures were obtained in traumatic effusions.

The author claims that this cytologic examination of the exudate is a valuable aid in the differential diagnosis of knee joints with effusion.—*A. Gottlieb, San Francisco, Calif.*

TENODESIS OF THE QUADRICEPS TENDON. Alfred Saxl. *Wien. kl. Woch.* Febr. 17, 1921. Page 71.

In complete paralysis of the leg, fixation of the knee alone will enable the patient to walk or stand. To gain this ability a splint, brace or arthrodesis of the knee joint is usually practiced. Arthrodesis of the knee joint is not practiced successfully in individuals below the age of 18, the author therefor recommends tenodesis of the quadriceps tendon instead. This operation leaves the joint and its capsule uninjured and is indicated in young individuals.

The author has performed this operation in five cases and has gained good results.—*A. Gottlieb, San Francisco, Calif.*

TEMPORARY NAILING OF FRAGMENTS IN FRACTURES AND OSTEOTOMIES. By Johannes Elsner. *Zeitschr. f. Orthopaed. Chirurgie*, XXXIX B. 1. Heft. Seite. 91. 1919.

In osteotomies and fractures near or through a joint the operator frequently encounters difficulties in holding the fragments, especially the one located proximally, in good apposition. The same uncertainty one has when placing the fracture in plaster cast without control of the Xray.

Temporary nailing with a long, preferably gilded, nail guards against this difficulty. The nail is introduced perpendicularly to the fragment above or below the site of bone division or better into the fragment near the joint. The nail protrudes through the skin. The protruding nail or nails enable the operator to manipulate the fragments into the desired position, to always judge in what relation the fragments are to each other and to fix the fractured or osteotomised bone perfectly in plaster of Paris without fear of displacement.

The nails or screws are kept in position for 2 to 3 weeks when, after a renewal of the plaster splint,they are removed. No serious consequences after such nailing the author has ever encountered although he has applied this method in over one hundred cases. A description of nailing in cases of coxa vara, genu varum and in fractures of the elbow follows.—*A. Gottlieb, San Francisco, Calif.*

RECOVERY OF NEEDLE FROM TENDON OF FLEXOR LONGUS HALLUCIS. W. Howard Barber. *Med. Record*, Oct. 30. 1920.

E. G. drove a needle into heel in 1920. During the past few days she has complained of pain in arch on walking. Tenderness is present under left plantar arch and stereoscopic X-ray shows foreign body underlying shaft of first metatarsal. Under guidance of anterio-posterior and lateral views, incision reveals a 3 cm. rusted needle within the fibres of the flexor longus hallucis. The stiffness of this portion of the tendon as though it may be calcified draws attention to it. Of special note in this experience are: the ten year interval, the progression of the needle, and the importance of the X-rays in localization.

The Second Great Type of Chronic Arthritis, a Laboratory and Clinical Study. Leonard W. Ely. *Archives of surgery* 1920, i. 158.

In this type of arthritis the author includes cases called arthritis deformans by the Germans, osteoarthritis by the English, hypertrophic arthritis by Goldthwait, degenerative arthritis by Nichols and Richardson, etc., etc. His clinical material consists of 90 patients seen at the Stanford clinics. His pathological material consists of fragments removed from many joints and of four femoral heads and one knee joint gained at resection. The clinical diagnosis was made by the Roentgen plate. If this showed spurring and lipping, the case was included in the series. The authors conclusions are as follows:

1. The great second type of arthritis has two distinguishing features: (a) bone production (lipping, spurring) at the joint line, and (b) absence (except in spinal involvement) of union between the ends of the bones, either fibrous or bony.

2. Its main pathologic feature is the presence of areas of aseptic necrosis in the bone near the articular surface. This is the primary change. The cartilage changes and the bone production are the result of it.

3. Its primary cause is probably infection in the alveolar processes of the jaws.

4. Infection in the jaws causes only this type of arthritis, never the first type

5. The infections which cause the first type, namely, tuberculous, syphilis, tonsillar and deep urethral infections, never cause this second type. The evidence for 3, 4, and 5 is purely circumstantial. It rests on clinical observation exclusively.

6. Mental emotion and disturbed digestion can only be considered as contributing causes, which change the secretions of the mouth, and make the infection in the jaws more active.

7. Trauma is effective only as straining a joint already mechanically damaged.

8. This is called the senile type of arthritis, merely because elderly people are prone to it. Alveolar infections are more common in the aged. It occurs occasionally in young people whose teeth and jaws are infected.

Cutting the Bone Flap in Cranial Surgery. H. C. Masland, M. D. *Annals of Surgery*, October 1920.

Dr. Masland discusses the various methods now used in opening the skull. The chief deficiencies of the more modern instruments are the possibility of injuring the underlying soft tissues and the wastage of bone. The relatively wide fibrous union of the bone flap does not furnish a rigid underlying bone support.

For cranial operations he uses part of an equipment designed for plastic bone surgery in general. The low speed motor eliminates burning. The cable

is ample in strength and is sterilizable. A Roberts trephine and a circular saw do the bone cutting. The small trephine is so constructed as to jam in the side wall and stop the motor the instant the resistance against the crown cutters is removed. The dura remains intact. The saw has an adjustable outside guard for preliminary partial depth cutting. The inside guard is attachable to the instrument. It is inserted in the trephine openings and dissects the soft tissues from the bone. It always intervenes between the saw and the separated soft tissues. A large flap offers operative advantages and no mechanical disadvantages. The distal side of the bone flap on reposition comes in positive contact with and is supported upon its adjoining skull wall.

THE OPERATIVE TREATMENT OF INFANTILE PARALYSIS.

The surgeon who treats paralysis of the lower limbs, takes a novel and rather peculiar view of the requirements of human activity. In this scale of requirements he recognizes three essentials: (1) That the patient should be able to stand on his feet and progress in some manner or other; (2) that he should be able to get up and down out of a chair; and (3) that he should be able to go up and down stairs. In regard to the treatment of patients who cannot walk, Robert W. Lovett (Surg., Gynec. and Obstet., January, 1921) contends that any patient of average intelligence with flaccid paralysis of the lower extremities, abdomen and back can be made to walk in some form or other, provided he has one good arm and one good enough to hold a crutch. The most common obstacle to putting a patient on his feet is contracture of the hip in flexion. This may be remedied by Soutter's operation (fasciotomy with detachment of the muscles surrounding the anterior superior spine of the ilium) or, in milder cases, by continuous stretching. Permanent flexion of the knee may prevent walking and is to be treated by gradual stretching. Equinus deformity of the foot is the third deformity which, if existing in both legs, makes walking practically impossible. In the treatment of this deformity tenotomy should be used with extreme caution. The contracture will in most cases yield to gradual stretching. After correction of the deformity the patient should be instructed in tripod walking. Crutches form the two anterior legs of the tripod, while the third and posterior leg is formed by the body of the patient inclined forward at its upper part with the feet well behind. Hyperextension at the hips is checked by the ilio-femoral ligament, the knees are held in splints and the weight falls in front of the hip joints and enables the patient to stand upright. The power of progression can be acquired. The most interesting and important problem in the treatment of infantile paralysis is that of improving the walk of those patients who are able to move about. In dealing with lameness the surgeon should carefully examine the abdominal and gluteal muscles. Correction of deformity in the feet will not greatly improve the patient's condition if these muscles are paralysed. The limp caused by paralysis of the gluteal muscles cannot be concealed or remedied by any apparatus, but is minimized by the use of a strong elastic band. The abdominal paralysis is much more common than has generally been supposed. The complicated limp may be minimized by

wearing a well-fitting corset. In the treatment of deformities due to paralysis, tendon transplantation has been successfully employed by the author, more especially by fixing the extensor hallucis longus tendon to the first metatarsal bone in cases of mild valgus deformity and by transferring the peroneus longus tendon to the medial side of the foot and by insertion of the tibialis posterior and one of the peroneal muscles into the os calcis in cases of talipes calcaneus. Tendon fixation has been proved to be satisfactory, although occasionally the tendons were stretched or pulled out of their attachments. Silk ligaments have been discarded. Astragalectomy when performed after the age of fourteen years is a good operation, but in young children the astragalus should only be removed in cases of severe calcaneus deformity. In cases of paralysis of the upper limb the minimum requirements for a successful operation are, firstly, power of flexion of hand and fingers and, secondly, ability to move the scapula on the thorax. Arthrodesis of the shoulder is the best procedure when there is paralysis of the deltoid. In the hand tendon transplantation is often of use, particularly for the improvement of the movements of the thumb.—*From The Medical Journal of Australia.*

A STUDY OF PERSISTENT BONE SINUSES. Dr. Charles Peabody, *Journal of S., G. and O.*, *November*, 1920.

The author was concerned in the treatment of some 500 A. E. F. cases arriving at general hospitals in this country after the armistice; and presenting persisting bone fistulae in spite of much and varied treatment and after running a protracted and stormy course. The pathology in all was similar, old compound comminuted fractures from gun-shot wounds followed by chronic osteomyelitis, and the resulting condition was proving a permanently intractable one by the persistence of the following factors: a bony chamber, infected and filled with fungosities, and surrounded by sclerosed, unregenerative and incollapsible walls Many modes of attack were observed with varying results, and from them a method of treatment was evolved and carried out on the cases operated by the author, about half the above number, which seemed to promise a permanent cure in a large majority. It consisted of an extremely radical ablation operation removing the entire area surrounding the lesion, and leaving in the bone a shallow basin instead of a deep cavity. The resultant healthy but still bacteriologically contaminated wound was kept wide open under rigid Carrel-Dakin technic until sterilization was complete and the bone buried under healthy granulation tissue, which required from two to six weeks. As complete cicatrization in this fashion was frequently unsuccessful and usually functionally disadvantageous, the wound at this stage was closed by a second operation usually performed under infiltration ansthesia, in which a free reconstruction of tissue planes was made, swinging pedicled flaps when necessary to fill dead spaces or meet a skin deficiency, thus minimizing scar tissue and thereby improving function. The healed wounds were successfully subjected to the therapeutic test of deep and prolonged massage, but lapse of time alone in these conditions can be held as an adequate criterion of cure.—C. P.

Harmer, T. W. *Boston Medical & Surgical Journal*, 1920, December 30, p. 775.

In the hope of dispelling a very general belief that operation should be postponed in cases of spina bifida until the child is stronger, Harmer presents a paper on the operability and time for surgical intervention in various forms of spina bifida based upon an operative experience of 38 cases with an operative mortality of 42.1 per cent. His series includes 8 meningoceles, 26 myelomeningoceles, 3 hydroencephaloceles, and 1 encephalocele. Of these 27 were rounded and sessile, 8 rounded and pedunculated, and 3 flat and entirely covered with membrane. Twenty-two cases had ulcerated or leaking sacs. The 17 deaths were due to meningitis, continued loss of cerebro-spinal fluid, acute hydrocephalus, and shock. Harmer has presented his technique of operating in a previous paper in the Boston Medical & Surgical Journal, September 13, 1917.

He summarizes his views on operability and time for surgical intervention as follows:

Rounded pedunculated sacs, entirely covered with skin, without paralysis —operation may be safely deferred for a long time, but it is better judgment to adopt the same criterion for operative interference as in the rounded sessile type.

Rounded sessile sacs, entirely covered with skin, without paralysis-operation should not be deferred longer than is necessary to determine that an equilibrium between secretion and absorption of cerebro-spinal fluid has been established, i. e., not longer than several weeks after the sac has reached its maximum size.

Rounded sessile sacs, entirely covered with skin, with paralysis-operation at once in the hope of forestalling inextricable adhesion of nerve elements. Post-operative hydrocephalus may occur but if we wait for signs of hydrocephalus to appear, we will likely miss the opportunity to cure paralysis by operation. Non-adherent nerve elements in the sac may be successfully replaced within the spinal canal, but nerve elements involved in granulation tissue of the sac cannot be successfully extricated.

Rounded sessile sacs, entirely or partly covered with membrane, without paralysis. With scrupulous care of the sac, a delay of a few days is justifiable to demonstrate the unlikelihood of post-operative hydrocephalus. Delay beyond this means excoriation and infection of the sac and poorer operative prognosis.

Rounded sessile sacs partially or entirely covered with membrane, with paralysis-operation at once, in the hope of finding nerve elements which are not inextricably adherent to the sac. With the head obviously hydrocephalic, operation is not justifiable.

Defects covered entirely with flat membrane, when narrow and with or without paralysis-operation at once.

Sacs entirely covered with flat membrane, when wide and with paralysis-operation unjustifiable.

The After-Treatment of a Dislocated Elbow. Ernest T. Saeger, M. D. *Boston Med. & Surg. Journal*, Nov. 4, 1920.

The use of early passive motion and massage following reduction of a dislocated elbow is contra-indicated because of the danger of formation of ossification in the neighboring muscles. The arm should be immobilized in acute flexion for three weeks in order to make the development of myositis ossificans traumatica less likely. The elbow joint seems to have a greater tendency than other joints to the formation of nodules of ossification in the muscles following trauma. The origin of new bone formation may be from osteoblastic cells which have wandered from the torn periosteum and proliferated, or it may be a meta plasia of the connective tissue of the capsule or intermuscular septa.

The case reported in this article was reduced under ether in the usual manner. The arm was flexed to an angle of about 60 degrees and immobilized for a period of three weeks. The arm was then given daily periods of baking, massage, and passive motion. Six weeks after reduction there was still marked limitation of extension. X-ray plates were made and showed no evidence of myositis ossificans. As the limitation of motion seemed due entirely to joint adhesions, the patient was again given a general anesthetic until there was muscular relaxation, and the adhesions were broken up without difficulty. Six weeks after the last anesthesia the patient was discharged with no limitation of motion at the elbow joint and no deformity.

Unfortunately in these cases the period of immobilization will almost certainly result in the formation of firm joint adhesions which will have to be broken up under general anesthesia. This treatment is wiser, however, than to permit nodules of ossification to form which will have to be removed surgically.

Transplantation of Cartilage. By W. T. Coughlin, M. D. F. A. C. S., St. Louis, Mo.

In the past 8 years and more particularly in the last 4, much attention has been given to the transplantation of cartilage. At Cecis' Clinic in Pisa, Italy, during the Turco-Italian war, the process came first prominently into notice.

In war wounds of the face, where loss of the underlying hard parts rendered the deformity more pronounced, resort was had to cartilage implantation for the purpose of overcoming the skeletal defects.

Cartilage lends itself most readily to transplantation. It is easy of access. The supply furnished by the individual himself is practically unlimited. Its removal does not impair his function nor leave disfigurement or deformity. It is easily worked into the desired form. It requires no elaborate mechanical device, for its removal or reimbedding, and as far as we are yet able to determine, it continues to live and retain its shape and size, and lastly, it must be mentioned that it is not so susceptible to the action of pyogenic organisms as are other grafts. It often heals in firmly, even after long suppuration of the wound.

Heteroplastic grafts do not long survive, but are absorbed and their place is taken by scar tissue.

J. S. Davis, in a series of experiments, concluded that even without any perichondrium the graft remained unabsorbed.

Bone requires, when transplanted, to be placed in contact with living bone and to be made to functionate, otherwise it is either absorbed or atrophies. Cartilage, imbedded anywhere in the tissues, retains its form and strength apparently indefinitely, unless subjected to greater stress of weight than that which it formerly carried.

For transplantation into the skull, costal cartilage is taken, split in the coronal plane and applied to the defect in a manner to conform with the skull contour. The periosteum loosened from the skull, the beveled cartilage placed in the skull and the periosteum stitched to it. The perichondrium is not removed from the graft. Perfect hemostasis is desired, sepsis is not to be feared as in bone grafts, as cartilage is much more viable. Union is fibrous. The graft seldom slips or becomes broken.—*Leo C. Donnelly, Detroit.*

Fissure Fracture of the Tibia. By Jacob Grossman, M. D., New York City, New York. *New York Medical Journal*, Sept. 11, 1920.

This paper is based on the study of twenty-one cases. It occurs commonly before ten years of age. It is the result of direct violence. The following conclusions are drawn:

1. Fissure fracture occurs mostly in children.

2. The tibia is usually the site of the fracture, only one case having been found in the fibula.

3. The subjective symptoms and the disability may be very mild.

4. Fissure fracture should be differentiated from sprains and contusions.

5. The presence of a luetic infection in the bone, as a factor prolonging the duration of the symptoms, should not be overlooked.

6. False mobility, crepitus and deformity are always lacking in this type of fracture.

7. The diagnostic objective symptom is "pencil tenderness." It is always present and persists for an indefinite period of time after the accident has occurred.

8. The recognition of this type of fracture is important, not only from a scientific viewpoint, but also from a medicolegal viewpoint.

9. The treatment consists of immobilization by means of plaster-of-Paris bandages, which are retained for a period of two weeks. They are then removed and baking and massages are given. The average length of time treatment was necessary was four weeks.

SUBLUXATION OF THE HEAD OF THE RADIUS. By Dr Jacob Grossman, New York City, N. Y. *Medical Record*, Dec. 11, 1920.

This paper is based on the study of thirty-seven cases. It is also known as "traumatic palsy," because it resembles a flaccid paralysis. It occurs commonly between the ages of a few months and five years. Swinging the child by the wrists or dragging the child by taking hold of the wrist is the common cause. Immediately thereafter the upper extremity hangs limply at the side and the child refuses to move it.

The writer concludes as follows:

1. Subluxation of the head of the radius is a fairly common condition and is often overlooked. It is often diagnosed as sprain of the shoulder or wrist or fracture of the forearm.

2. It occurs only in children, generally between the ages of eight months and five years.

3. The mode of production and the subsequent picture, namely raising or dragging the patient by gripping the wrists and the apparent flaccid paralysis, are characteristic of this condition.

4. It is often called "traumatic palsy of the upper extremity.

5. Extreme forcible supination is all the treatment required to overcome the subluxation. After care is not necessary.

6. As relapses may occur parents should be warned of the risk of dragging or lifting their children by gripping the wrists.

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THE SUPPLY OF ARTIFICIAL LIMBS TO WAR AMPUTEES IN ENGLAND

BY E. MUIRHEAD LITTLE, F. R. C. S. LONDON

The three years which have passed since the publication in the American Journal of Orthopaedic Surgery in April 1918 of the writer's paper on Amputation Stumps have not caused him to modify the opinions then expressed to any great extent. The following remarks however embody the results of this further experience. The return of former patients for repairs to their limbs etc., has afforded opportunity of judging to what degree the provision of end-bearing pads in artificial legs had proved satisfactory.

It may be remembered that in the paper above referred to it was stated that it had been thought advisable to prescribe such pads for fifty per cent of the lower limb amputees. As it appears obvious that it was desirable whenever possible to use the end of the stump for purposes of support, so relieving the circumference and upper parts of it, a number of cases were ordered end-bearing some of which were only questionably suited to it. As the sling and pad were simple additions to the limb, no harm would be done if the patient found it uncomfortable or painful, as he could easily remove the pad himself.

In March 1920 220 consecutive cases to which end-bearings had been supplied were examined on their return for repairs or for duplicate limbs.

Of these 124 were above knee amputations.

Of these 8 were through the knee joint.

Of these 88 were below the knee.

Of the 124 above knee cases 84 or 67% were using the pad. Of the 8 through knee cases all, or 100%,* and of the 88 below knee cases 68 and 77% were so doing. Of the 220 cases taken together 160 or 72.7% were using the end-bearing.

Thus as 50% of all cases were ordered it, it may be taken as established that about 34% of all above knee cases will be found to be able to use end-bearings.

Another point which has come out is the occurrence of nerve pains in stumps after prostheses have been worn without pain for a year or more. These appear to be due to atrophy of the soft parts, owing to which nerve trunks which were before affected, may become exposed to the pressure of the socket and give such trouble that resection and alcoholic injection of the nerves become necessary.

The Ministry of Pensions is responsible among other things for the supply and upkeep of artificial limbs and appliances to pensioners. Neither the Ministry nor the Commissioners of the Royal Hospital at Chelsea, on whom this responsibility formerly lay have thought fit to manufacture artificial limbs.

The productions of a number of firms of limb-makers have been inspected and when found satisfactory have been approved and surgeons in charge of limb-fitting hospitals and centres are at liberty to order of any of these approved limbs. But the official list of limbs thus approved included many different types, from the old dummy artificial arm and the "Clapper" or "Railway" leg (so called because it has been made by certain Railway Companies for supply to their employees) to the Carnes or McKay arm, and the lighter modern artificial wooden leg with knee control. This variety of types and quality was the result of the demand outrunning the supply so that limbs were approved which perhaps might have been rejected had the need for limbs been less urgent. It has been decided that every amputee shall have two artifical limbs for each stump and these shall be repaired and replaced when necessary as long as he lives. A large number of second or duplcate limbs have already been supplied, and the return of these pensioners for fitting has enabled limb fitting surgeons to form some opinions as to the usefulness of the first issues.

*It must not be assumed that every case of amputation through the knee joint was fit for end-bearing. It simply means that in the 8 cases noted our prognosis was correct.

As regards leg protheses, the Ministry has since the Armistice, on the advice of surgeons and limb-makers, decided on a number of standard types of limbs, which the members of the British Limb-makers Association have undertaken to manufacture and supply; metal parts of standard patterns being furnished by the Ministry. It is hoped that 'ere long all new limbs will be of one standard pattern for each kind of amputation. Maenwhile however, there are all sorts of limbs in use, which from time to time need repair and replacement and the surgeon to a limb-fitting hospital is confronted with the problem of how to satisfy the desires of the pensioners and at the same time to see that each man has adequate appliances.

In the issue of the first limbs to amputees the wishes of the patient could seldom be any help to the surgeon, because the former had no experience of protheses and could seldom tell what was good for him. The responsibility of selection therefore rested almost entirely upon the surgeon.

But now the case is altered. It is recognized that the man who has not merely been in possession of but has regularly worn a certain type of limb is generally a good judge as to whether it suits him or no, and that he has the right of choice of a new one. As regards artificial legs, experience teaches us that:

There is no artificial limb so old fashioned, and apparently inadequate, but that some amputees will swear *by* it and will take no other for a second issue.

There is no artificial limb so well designed, constructed and fitted, but that some amputees will swear *at* it and say that they "would not be seen dead with it!"

Arm prostheses are neither so necessary nor so useful as those for the lower extremity. The functions of the upper extremity are far more delicate and complicated and require a much higher degree of co-ordination of muscles and nerves than do those of the leg. Consequently it is possible to approach more nearly the ideal of a true and complete substitute in the latter than in the former case. The foot of boot-wearing man has ceased to be used as a prehensile organ and the functions of the lower extremity are confined to locomotion and the maintenance of the erect position. The leg amputee who has no prosthesis, cannot move easily from place to place except with the help of crutches and for him there-

fore a prosthesis is a necessity. On the other hand, those who have lost one arm in many walks of life can do as well with one sound hand as with two, and a number of them have declared, after they have adapted themselves to a one armed existence, that they hardly knew what they wanted with two hands formerly.

Those who have had the misfortune to lose both hands are in a different category altogether. Thus, while it is more difficult to make good the loss of one hand or arm than that of a leg it is fortunately less necessary to do so. To the labourer however and to the handicraftsmen whose work is bimanual a prosthesis is necessary and the more simple the efforts required, the more useful will it be. The agricultural labourer may be capable, with a comparatively simple prosthesis, of doing a good hard day's work, equal in some cases to what he could do before his disablement. In France where so large a proportion of the population works on the land, it has been found that such occupation is best suited to the arm-amputee.

The most important factor however, in the estimation of the value of an arm stump or stumps is the character of the patient himself. Those who have pluck and perseverance: in short are so fortunate as to be endowed with the will to make good, will succeed in the use of almost any prosthesis and the better that prosthesis is, the better will their work be. There are others who are easily disheartened after a short trial, or who will not try at all.

It is unfortunately true that a large number of amputees who were provided with arms by the Government did not wear them. An enquiry made by the Ministry of Pensions in 1918 elicited the information that out of 1746 men amputated above the elbow only 20% used their prostheses in their occupations and that out of 737 amputated below the elbow 48.5% so used them. 57% of the above elbow cases and 30% or the below elbow cases however, were engaged in occupations which did not require the use of two hands.

As many of the arms concerned were of old patterns, a second and more detailed enquiry was made in 1919 into the usefulness of 1354 arms issued in 1917. This enquiry elicited a rather more encouraging report. It is to be noted that of the total number there were more left (717) than right (637) arms. The

enquiry cannot however be considered complete, as a considerable number of those circularized did not reply.

The institution since this enquiry of systematic training of all arm amputees in the use of their prostheses at limb fitting hospitals and the improvements in the design and manufacture of arms, will it is to be hoped, result in greatly increased usefulness of arm prostheses among the wounded of the great war. These statistics confirm the conclusion to which most observers had already come, that the problem of the provision of above elbow prostheses is distinct from and more difficult of solution than that of the below elbow.

The plight of the man who has lost both hands is distressing, even if he labours under no other disabilities and if he have two long forearm stumps. With such stumps it is surprising how much a man can do for himself without prostheses, for by bringing them together he combines them into a prehensile organ or rudimentary hand, which has the great advantage over a prosthesis of possessing tactile sensation, which becomes more delicate with prolonged use. With the loss of each inch of bone in one or other stump the disability increases, until the lowest depth of deprivation is reached in the man who has lost both arms at the shoulder joint or a few inches below it. These unfortunates are happily few in number, but their case needs as much consideration as that of the more frequent amputations. A remarkable facility in writing with a pen or pencil held in the teeth may be developed, many other light tasks may be performed by means of a stick generally held in the mouth but the best hope for them lies in the utilization of the feet when these are uninjured. Whether mobility and prehensile power in the toes could be developed by giving up the constant use of shoes and stockings is yet to be demonstrated, but the remarkable usefulness of the feet to those who have been born without hands suggests the propriety of further study in this connection. In 1916 Mr. C. A. Sheehan invented a table fitted with levers to be worked by the feet for these cases[1] and Mr. George Thomson of Edinburgh has since devised a most ingenious machine on somewhat similar principles which enables the truly armless man to do a variety of things.[2]

[1]See British Medical Journal 5-5-17 p. 583.

[2]See British Medical Journal 3-1-20 p. 20.

This machine however is stationary and the patient is nearly helpless when he leaves it. Attempts have been made to design a prosthesis of which the motive force is supplied by movements of the thigh and leg, but up to the present time (1921) they have not resulted in anything of much practical value.

Not only in these extreme cases but in all those of loss of both forearms or of more, the patient is unable to dress himself or to attend to the common needs of daily life or the calls of nature and must depend upon the constant service of an attendant or relative. Even a cold in the head is a severe increase to his troubles, so that it may be found best for him to keep his bed during an attack of catarrh.

In the case of all arm-prostheses, the design and details of manufacture present the greatest difficulties and are more important than the fitting of the socket to the stump.

In leg prostheses on the contrary the converse obtains. Fit is more important and more difficult than design and manufacture of the parts other than the socket.

Indeed, it may be said that the crudest and worst type of artificial leg with a well fitting socket and well aligned and balanced is better than the best and most elaborate type, if ill fitted and badly aligned and balanced.

A very large number of artificial arms, both ornamental and "workers" of various makes have been supplied. By the latter term is meant an arm which scarcely pretends to resemble the natural limb, except that an artificial hand can be worn on it, but that is intended primarily as a working mechanism for the use of a hook or special appliance.

The pensioners who have returned to Hospital during the last year or two in order to have repairs and readjustments made, or for the supply of duplicate limbs appear to have found all sorts of things useful, according to their occupations, but many of the above elbow amputees complained of the weight of the arms and chose a new light but strong ornamental prosthesis which weighs with a wooden hand and equipment under two pounds. The stump sockets and the forearm parts of these arms are made of "Certus" glue and a woven fabric and are very strong and light. Duralumin is largely used for the metal parts.

NOTE—For a description of Duralumin and its uses in Orthopaedic appliances see the author's lecture on "a New Material for Surgical Appliances." British Medical Journal. 3-2-12. Page 236.

Such arms are supplied as ornaments on "Dress Arms" but they are strong enough for light work. The elbow is flexed and locked by shoulder and chest action and the hand can be detached and a hook or other appliance substituted. Despite their lightness these arms are stronger than the old pre-war ornamental arm and hand without any elbow control.

The earlier working arms for shoulder amputations, made without any joint at the shoulder have been abandoned, and two types having artificial shoulder joints and elbow control have been substituted. One of these is a strong working prosthesis of stiff leather and steel, useful for heavy labour. The other is made of glue and fabric and duralumin and is an ornamental or "dress" arm. Many pensioners are now fitted with one of each type. The working arms of stiff leather and steel which were supplied for short upper arm stumps—two or three inches long, measuring from the anterior axillary fold, which had a steel artificial shoulder joint have not proved successful. Many of these were issued but few have been worn, or if worn have proved useful. The short stump has proved unequal to the task of moving the prosthesis and the limb is laid aside on account of the fatigue caused by the attempt.

It is evident that very few men use an artificial hand in their work. A limited number of those of the "white collar" class, clerks, commercial travelers, messengers, etc., have found the Carnes hand and arm advantageous to them despite the fact that appliances cannot be substituted for the hand. Another type with a fixed hand is the Pringle-Kirk arm, which has a hand, the fingers of which are made of steel spiral springs backed with stiff leather. These fingers and the thumb can be closed on any object by working a lever situated at the wrist with the sound hand. This lever acts on the fingers by an ingenious ratchet movement.

Although this method appears clumsy, the hand has proved useful for hard work and those who wear it report favourably of it. Such an arrangement has the drawback that the grasp cannot be relaxed instantaneously, which in an emergency may be necessary. The power of quickly detaching an artificial hand or appliance is of great value and on it a man's life may depend when he has to deal with machinery, horses, etc. For this reason among others the screw attachment of hands and hooks, etc., to the wrist

has been given up in favour of a spring catch snap, which is worked by a button at the side of the wrist. These catches save much time to a workman who has to change from one appliance to another.

A working arm which has found much favour with the returning pensioners is the McKay. The patentee of this arm has himself lost a hand and worked out the invention primarily for his own use. Duralumin is largely used in its construction and as in the Adams Arm the stump socket is made of this material. The distinctive feature of these arms is the rubber hand of which the fingers and thumbs are stiffened by central copper rods. The fingers can be bent to any shape desired and the thumb is flexed by a strong spiral steel spring and extended by shoulder action. The copper rods although malleable are yet stiff enough to enable quite heavy weights to be raised in the hand-grip. This is unquestionably a useful hand, but many men make little use of it, preferring appliances for their work.

In the discussion upon Vanghetti's Kineplastic amputations* at the meeting of the British Orthopaedic Association in November 1919 hopes were generally expressed that a useful working prosthesis for such cases would soon be forthcoming. Unfortunately up to the present time these hopes are unfulfilled, and there seems little present prospect of success.

The chief and probably insuperable difficulty lies in the want of power and sufficient range of movement in the motors. It is true that some motors can lift when directly harnessed to a weight or a dynamometer, as much as 20 lbs., but this is trifling compared with the force that must be exerted by the normal muscles at the points of insertion of their tendons. The plastic motor like the natural muscle must act on a lever at a disadvantage, so that a twenty pound pull may result in a grip of only three or four pounds. If the lever is lengthened in order to gain power, a longer excursion is needed than can generally be afforded, and mechanical difficulties are increased.

Some German writers have insisted on the necessary distinction between the palmar grasp for large and heavy objects and the finger-end grasp for small and light objects and they have devised different hands for these different grasps. Many men can

*See Journal of Orthopaedic Surgery. April 1920, page 212.

exert a force of 35 lbs. by the former and 10 or 15 lbs. by pressure between the end of the thumb and index finger in the latter.

Anything approaching this force is not to be hoped for from plastic motors, but for very light work or ornamental purposes prostheses for kinematized arm stumps, will probably prove practicable. For the lower extremity there is little need but more hope of success with the method.

The improved prostheses for the lower limbs which were available in 1915 and especially those for exarticulations at the hip, were so much better than most amputees expected, that they were very well received and there was little grumbling. There is now however an outcry for lighter limbs and attempts were made to satisfy it by the government and by limb making firms.

Duralumin and Celluloid and the combination of glue and muslin, above referred to as used for arms, are the materials which have been successfully tried, but the writer's experience leads him to believe that willow wood is still the best known material for stump sockets, and that the best light limb is one in which the wooden socket is combined with a frame-work and joints of duralumin or some similar alloy. There is however little demand for a limb lighter than those hitherto issued for below knee amputations, but even here a lighter foot will probably prove advantageous and is being experimented with. There is need of a lighter prosthesis for Syme's amputation, for the average weight of the regular patterns is about 3½ lbs. and there is a prospect of reducing this by one or one and a half pounds.

It may interest American surgeons to learn what are the average weights of the limbs (including hands) supplied at Roehampton at present for the commoner types of amputations.

They are as follows:

	Worker's arm	Dress arm
For shoulder amputations	4 lbs.	2 lbs. 6 oz.
For above elbow amputations	3 lbs.	2 lbs.
For below elbow amputations	2 lbs.	14 oz.

Artificial Legs

No. 1. For hip amputations	9 lbs.
No. 2. For short thigh amputations with steel hipjoint and pelvic band	6¾ lbs.

No. 3. For longer thigh amputations, below the middle of the femur .... 5¼ lbs.
No. 8. For below knee amputations .... 4¾ lbs.

Light duralumin limbs can be made for the above types weighing No. 1—6½ lbs., No. 2—4¾ lbs. and No. 3—4¼ lbs.

A limb with a well fitting socket feels much lighter to the wearer than a badly fitting one of the same weight, and a well balanced one lighter than an ill balanced one. It is to be desired that the centre of gravity of a No. 2 limb (i. e. one for thigh amputation, without metal hip joint or pelvic band) should be situated at or just below the Knee bolt.

The position of the artificial joints of limbs in relation to the centres of the corresponding natural joints is important and has been lately insisted upon by limb fitting surgeons. Limb makers have been generally in the habit of placing the artificial hip-joint in No. 2 limbs far too low. It has been demonstrated to them that this practice causes difficulty in walking and friction between the stump and the socket. The correct position is now insisted upon. This, in the case of a normal hipjoint is slightly above the level of the tip of the great trochanter and in front of it. How much in front of it it should be, depends upon the amount of rotation of the femur stump.

No one familiar with the problems involved in the manufacture and supply of prostheses will assert that finality has been reached. There is still room for and hope of improvement in details at least. Such information as we have of the artificial limbs hitherto supplied in other countries has not led us to imitate them. Certain American types of artificial limbs were of very great help to us at the beginning of the war and we think that they have been improved upon in the workshops in this country.

May we not look to the ingenuity and resource of American engineers and mechanics to make some revolutionary and as yet undreamt of advance in prosthetics?

THE MUSCULATURE OF THE FOOT, AND ITS TREATMENT BY ELECTRICITY

G. MURRAY LEVICK, LONDON

In dealing with the electrical treatment of the foot, I will take first that class of case in which nerve interruption or inhibition has led to degeneration of the muscles supplied by the internal popliteal nerve.

When a motor nerve is moderately injured or compressed, the first muscles to show R. D. and the last to recover are those that it supplies farthest below the seat of injury. Also as a rule they are the most profoundly affected, and after suture of a nerve they are the last to recover. Consequently in the cases with which we are dealing, we should always at once turn our attention to the intrinsic muscles of the foot, all of which, with the exception of Extensor brevis digitorum, are supplied by the internal popliteal nerve. Later on I will call attention to the extreme importance of these muscles, and show why in all cases where the internal popliteal nerve is affected, we should especially concentrate on the treatment of the foot. This is a point that is generally neglected.

Up to the end of the war, most of the cases of nerve injury that came under my care, exhibited tissues in the first stages of degeneration, and the affected muscles were in at least a fair state of nutrition and contractibility. Their treatment was therefore a simple matter. Suitable posture and galvanic contraction by the longitudinal method, with a little massage, were all that was needed to keep them going until regeneration had taken place.

Nowadays however, we find a very different state of affairs. Patients crop up from all sorts of holes and corners in which they are being discovered, suffering from nerve injuries inflicted years ago, but undiagnosed and left all this time without the special treatment they demand. In most cases these muscles have degenerated seriously. Sometimes actual fibrous degeneration with vacuolation renders their recovery impossible. In other cases it is touch and go.

With great care and perseverance we can coax some of these muscles back to usefulness, where ordinary routine treatment would fail absolutely.

One of the most noticeable things about a case recovering from internal popliteal nerve injury is the length of time that usually passes before the toes are bent on stimulation of their long flexors. It may be many months after recovery of the calf muscles, and I have observed a faradic response in Abductor hallucis before it was apparent in Flexor longus digitorum. I believe this is due to paralysis of Accessorius so that the tendons of Flexor longus digitorum are not taughtened by that muscle, and its contractions, after its recovery to faradic stimulus, are absorbed in the process of "taking up the slack."

In cases we now commonly see, where the intrinsic muscles of the foot have been neglected so far that they will never recover properly, this is a disability to be counted on. Another point to be carefully guarded against is the fixation deformity of the tarsal joints as a result of general failure of the blood supply to the foot.

To turn now to the subject of treatment. In all cases where the Internal Popliteal nerve is involved, when giving galvanic treatment to the leg muscles, I have the patient seated on a couch with his foot placed flat on the bottom of an ordinary porcelain arm bath placed on a chair. The masseuse sits on another chair so that the foot and leg are at a convenient height for her. The indifferent electrode, made of carbon, is placed in the water facing the toes all the time the active electrode is being used upon the leg muscles so that the current, interrupted by the nutronome, streams through the foot and scatters through the small muscles which all get a share of the treatment. When I first tried this method, the improvement of the nutrition of the whole foot was so remarkable that I have adopted it as a routine.

It is certainly a fact that the nutrition of the foot improves long before the muscles show any signs of response to faradic current, and this is probably due largely to the action of the interrupted galvanic current in restoring the muscular coats of the arteries. During part of the treatment, the current should be reversed so that the foot muscles get the benefit of the anodal and of the current.

Having outlined the above treatment, I will not proceed to the treatment of feet unaffected by nerve injury, and to an interpretation of the roles played by some of the intrinsic muscles, which appear to be of great importance, and which I have not seen recorded in any of the text books on Anatomy.

The treatment is applicable when the preliminary stages of flat-foot are curable by physio-therapy, and to the after treatment of those more advanced cases which have been wrenched and fixed in plaster, or undergone surgical operation.

Regarding the first class, there are many people walking about the streets, suffering from what they describe as tender feet, and these people, experiencing pain on movement of the tarsal joints, avoid this as far as possible by planting their feet flatly on the ground, with the toes pointing too far outward. This leads them through the successive stages of flat foot.

The commonest causes of tender feet apart from uncleanliness, are deformity of the first metatarso-phalangeal joint, and passive wasting of the intrinsic muscles together with compression of the soft tissues by ill-fitting boots and shoes.

Of the first of these causes it is enough to say that almost the whole of civilisation is engaged in deforming its feet by dragging the great toe outward so as to stuff it into a boot which fashion decrees shall be shaped like a lead pencil.

The wasting of the intrinsic muscles and compression of the soft tissues are due to the support given by the boot which relieves some of these muscles of their proper role, so that they fall into disuse, become wasted and unhealthy, and a ready receptacle for fatigue products and other toxins, and the circulation of the whole foot becomes impaired, the tarsal joint suffering in common with the rest of the part.

As walking in the manner described above, entails the relaxation of Tibialis posticus and the toe flexors as well as the other intrinsic muscles of the foot, re-development of all these is needed in order to regain muscular support for the foot.

The role played by the flexors of the toes, (especially Flexor brevis hallucis and Flexor brevis digitorum) in supporting the longitudinal arch of the foot, is a very important one indeed, because when the weight of the body is thrown forward onto the toes with the heel off the ground, the action of both long and short flexors is to draw the heel towards the toes, acting as bowstrings across the arch from heel to toe.

For this reason the correct way to land from a jump, is to have the whole weight of the body borne between the balls of the

feet and the end of the toes. Also when patients are given heel-raising exercises from the standing position, this distribution of the weight should be carefully taught, by telling them to "grasp the floor with the toes," which thus become the fixed points from which their flexors act.

Flexor brevis digitorum, being inserted into the basal phalanges, is at a mechanical disadvantage in bending the toes, compared with Flexor longus, and therefore acts more strongly as an arch raiser.

The flexors of the toes should be used to assist progression in walking quickly or running, those of the great toe being of special importance.

With the above notes in mind, the efficacy of the following treatment will I think be clear.

The foot is placed in an ordinary porcelain arm bath as before, but in this case the heel rests on one carbon electrode while the other, being the other terminal of the circuit, is dipped in the warm water which should reach to just below the malleoli.

This electrode is held in the left hand while the other hand is used to manipulate the core of a Smart Bristow coil. Graduated contraction of any of the intrinsic muscles of the foot can now be obtained in a particularly useful and pleasing manner. It is almost similar to a method I devised about three years ago for the treatment of certain stages of trench foot, and described in the British Medical Journal. As we proceed to carry out this treatment and place the active electrode in the position needed to stimulate the desired group of muscles, a very clear view is gained of the action of the dorsal interossei in raising the transverse arch of the foot. It is seen that this is a strong action and emphasises the importance of these muscles. As the core of the coil is introduced and withdrawn in a rythmical manner, the transverse arch is seen to rise and fall and the foot to narrow and widen in time with the rise and fall of the current, and a clear mental picture can be formed of the dorsal interossei, with their bi-pennate origins, drawing the metatarsal bones together. To describe the action of one of these muscles will suffice to explain the action of the rest. We will consider the second metatarsal bone as the "keystone" and as the middle line.

When the second dorsal interosseus muscle contracts, it performs the following roles in the order given. These roles have been carefully observed during electrical stimulation of individual muscles, and then of the group as a whole.

(1) Feeble contraction. Abduction of first phalanx from middle line.

(2) Stronger contraction. Flexion of metatarsophalangeal joint, plus the pull on the extensor tendon. End of toe brought into contact with the ground. (In voluntary movement, this contact is of course strengthened by the long and short flexors.)

(3) Powerful contraction. The fixed points from which the muscle acts are now (a) the second metatarsal bone, (b) the insertion of the tendon into the first phalanx. As the muscle contracts, the third metatarsal bone is drawn towards the second, i. e. towards the middle line.

In voluntary movement, the second metatarsal is fixed by the opposition of the first dorsal interosseus muscle, which also fixes the first phalanx of the second toe, while it is drawing the first metatarsal bone towards the second, and so on.

As each metatarsal bone is drawn toward the second metatarsal, it is pulled into a plane below that of its more mesial neighbour.

If the technique above described is properly carried out, it will be seen that the arch raising action of the dorsal interossei is very powerful, and that these muscles must be regarded as of great importance.

Still more strongly is the impression given of the action of the short flexors of the toes in raising the longitudinal arch while the toes, acting as fixed points, press the bottom of the bath. The marked action of Abductor hallucis shows how it can still be trained to assist in maintaining an improved position of the great toe, should it be desired to correct this by mechanical means.

Having now given the required exercise to the intrinsic foot muscles, Tibialis posticus and the long flexors of the toes can be stimulated by disconnecting the active carbon electrode from its rheofor, which is now inserted into a button electrode covered by a handful of wet lint and applied to the desired motor points in the leg. The longitudinal arch will be seen very plainly to rise at

each contraction of the long toe flexors as well as of Tibialis posticus.

The method of electrical treatment outlined above is strongly to be recommended as a preliminary to voluntary exercise. It is a waste of time and discouraging to the patient to being re-education before the intrinsic muscles of the foot are in at least a fair state of nutrition. I regard it as inseparable from the satisfactory treatment of flat-foot, after seeing the surprisingly good results that it yields. Often it is extremely difficult or impossible to re-develop the small muscles by voluntary exercise alone. This applies especially to those cases that have been repostured by surgical methods, so that they are suddenly relaxed after a long period of overstretching with its accompany atony.

Discussion

Mr. R. C. Elmslie: Mr. Levick has called attention to a group of muscles which everybody, including ourselves, have been apt to overlook or to neglect too much in the past. The intrinsic muscles of the foot are not vestigial remnants from the time when the foot was used for another purpose: they have a real function in the use of the foot at the present day. Not so much in my hospital practice, but in private I seem to be continually occupied in treating people who have, apparently, good feet, but they are causing them trouble, for the reason that they are using them all wrong, and generally because they have lost the transverse arch of the feet, and have forgotten how to use their intrinsic muscles. These people I have been trying to re-train to use those muscles, to get their toes on to the ground, and make use of the toes as factors in progression at each step.

What interested me particularly in what I heard was his demonstration of the action of the dorsal interossei, not merely as flexors of the metatarso-phalangeal joint, but as elevators of the transverse arch. If that is true—and I do not suggest it is not true—it is new to me. If these dorsal interossei can be worked up, here is a possibility of improving these people who have a flattening of the transverse arch, people whom most of us have been in the habit of considering beyond mechanical correction, and as only capable of being made reasonably comfortable. If Mr. Levick can show that he can elevate that arch by working up the power of the dorsal interossei, here is a possibility of curing dropping of the transverse arch of the foot, a very important point indeed to all foot surgeons.

Mr. Aitken: I endorse the appreciative remarks made by Mr. Elmslie, and I regret that illness prevents our colleague Mr. Trethowan from being with us, as there is no subject which would have afforded him greater pleasure than a discussion relative to the flexors. Those of us who have been demonstrators of anatomy will agree that we have frequently to point out

the position of the dorsal interossei as being more towards the plantar aspect than we were inclined to believe, and I think Mr. Levick might have made more of that origin, in which there is produced that gripping action, and of which he gave us a demonstration, such as I have not before appreciated.

I have not previously regarded Mr. Elmslie as a pessimist, and his statement that these cases of flat foot are beyond mechanical correction is a statement with which we cannot all agree. But there is one thing which arises out of Mr. Levick's paper in relation to transverse flat-foot to which I intend to pay even more attention in the future; the deliberate treatment of toe movements and trying to re-educate these people to use their toes, so getting the middle of the arch to come up. We should appreciate a demonstration of that, if it could be given.

Mr. Levick (in reply): I thank Mr. Elmslie and Mr. Aitken very much. I want to make quite clear that the electrical treatment I advocate is only as a preliminary to voluntary exercises, never with the object of taking their place altogether. The point is, that when we start on these muscles they are often, so much wasted that we throw away weeks, perhaps months, in trying to get the patient to use them voluntarily, whereas faradic means first will enable exercises to be used effectively at a very much earlier stage.

STATIC DEFORMITIES AS A FACTOR IN THE PRODUCTION OF SO-CALLED HYPERTROPHIC ARTHRITIS

ROBERT PATEK, M. D. SAN FRANCISCO.

In the present confused nomenclature of the arthritides it is necessary at the outset to define exactly the particular condition one is dealing with. In this paper the classification of Ely[1] is followed. He divides the chronic arthritides into two types.

Type I. Those that show no bone production at the joint line nor spurring at the lines of insertion of the capsule. In this type the tubercular, gonorrheal, luetic, typhoid organisms, etc., are the exciting causes.

Type II. Those joints showing spurring. "In the latter type the gross changes are: cartilaginous and bony lipping at the circumference of the joint, with lipping at the intersection of the capsule; thickening of the cartilage, then calcification and erosion leaving the underlying bone bare; condensation of this bone (eburnation) with grooving in the line of joint motion; thickening of the synovial membrane with or without villous formation. On section the essential feature is an aseptic necrosis with cavity formation in the bone a short distance from the joint surface." Ely believes the primary change is in the bone and bone marrow; the cartilageous changes are secondary.

At the Stanford Orthopedic clinic during the last year, July 31, 1919-July 31, 1920, 72 cases of hypertrophic arthritis were admitted out of a total of 846 cases; namely 8½%. Alveolar infection was present in about 90% of these cases. This is probably more than a coincidence. But cultures made from these joints (operated upon by Doctor Ely[1]) have always proved sterile. Likewise no organisms have ever been found in sections.

Until Koch's criteria are fulfilled: namely, the isolation of an organism in pure culture and the reproduction of the disease with it, the acceptance of infection as the etiological basis must be held in abeyance.

[1]Ely, Leonard W., Archives of Surgery, Vol. I. The term hypertrophic arthritis is not used or approved by Ely; instead he uses the term Arthritis Type II. Hypertrophic arthritis is a misnomer. The process is in fact an atrophic one. The Germans call the disease arthritis deformans.

It is with the factor of the trauma of strain as the basic cause of hypertrophic arthritis that this paper deals. An article by Preiser[2] "Static joint diseases, their etiology and their relation to arthritis deformans" gives a detailed account of his idea of the steps that begin with static strain and lead to hypertrophic arthritis. The first step is a change in relation ship of two articulating surfaces. Thus in fracture of the femoral neck there is practically always some displacement of the proximal fragment and this in turn brings about a change in the relationship of the cartilage of the head with the cartilage of the acetabulum. Also the soft tissues of the joint are subjected to strain and there is torsion of the capsule and ligaments; with this goes a change in the nutritive vessels that run into the joint; there now follow structural changes; namely, fibrous change in the cartilage; it will degenerate and the condition of lipoma-arborescens arises; and finally the condition characterized as arthritis deformans is seen. The static change need not be due to fracture but any condition that produces abnormal joint relationships may initiate the process of hypertrophic arthritis; thus: coxa vara, flat foot, etc. And the change having taken place in one joint, of necessity throws the related joints under strain and initiates similar structural changes in them. Where Preiser finds two adjacent (hypertrophic joints) he believes that one precedes and gives rise to the other. This is the very essence of his theory. But it would be quite as logical to assume that two such joints arose independently from like or unlike causes. In other words, both might be due to infection.

Hypertrophic arthritis is essentially a disease occurring late in life. Our youngest case occurred at twenty-six years of age. Yet many deformed individuals have their joints under abnormal strain from the time they begin to walk. Accepting Preiser's theory, it takes such individuals never less than twenty years, usually over thirty years, to prove his thesis. Lastly, Heberden's nodes, one of the classic findings in the disease cannot be related to strain.

There is an economic interest to Preiser's theory. If hypertrophic joints arise from the trauma of strain, workingmen in occupations which place joints under abnormal strain are entitled to compensation, should they develop hypertrophic arthritis.

[2]Preiser, Georg. Static joint diseases, their etiology and relation to arthritis deformans. Am. Jour. Arth. Surg. 1912-1913 X 100.

Ely and Cowan* have done a series of experiments, shedding some light on this subject. They repeated in part the work of Axhausen. "Archiv fur Klinische Chirurgie 1912 xcix 519" Axhausen working on rabbits and dogs injured the joint cartilage with an electric needle. He stated that lesions typical of "arthritis deformans" followed, namely a "dissecting inflammation in the marrow and the formation of "Randexostosen" (lipping) at the circumference of the cartilage of the injured bone and that of the other bones of the articulation." In other words, injury to a joint cartilage initiated and established the changes seen in hypertrophic arthritis. His method is not exact. He probably injures the marrow as well as the cartilage.

The experiments of Ely and Cowan are grouped under three heads depending on the amount of injury done to the cartilage of the intercondylar surface of the femur.

In the first group the cartilage was simply cut to the bony buttress or gouged out; or burned with the actual cautery to the bony layer. In no case did anything resembling hypertrophic arthritis result. The cut edges tended to squeeze their edges together. Where the cartilage is gouged out the tendency is for it to grow in but leave as a rule a pitting. Where the cartilage is burned out the hole may fill in with fibrous tissue which latter becomes cartilaginous; in the majority of the cases the repair is slight and incomplete.

In the second group of experiments a large area of cartilage between the condyles of the femur was removed with a scalpel. The results here are most variable. The cartilage may fill in partly or completely or remain entirely absent. This latter holds for the majority of cases. In a few cases changes corresponding to Axhausen's Randexostosen were found, but in the great majority these changes did not take place. In the great majority the joint changes were localized to the area of injury; in other words, no general joint changes were set in motion.

In the third series the cartilage was removed from the intercondylar groove and partly from the condylar eminences. A hole was bored through the bone to the marrow. The results in this series are as follows: New cartilage is formed over the denuded

*Ely, Leonard W., and Cowan, John Francis, Bone and Joint Studies, Leland Stanford Junior University Publications, University Series 1, 1916.

areas more or less completely. This new cartilage is formed to a large extent by the synovial membrane spreading in from the circumference. As this new cartilage growth is more complete than in the second series it seems likely that the marrow takes part in the formation of new cartilage. In fact, the whole process of plugging up the hole with bone and cartilage in this series seems to have been through the activity of the marrow. The new cartilage is always irregular in structure and usually in outline. The hole is always closed by bone and the bone trabeculae are thickened. The joint changes are limited as a rule to the injured area. Function remains perfect. The new formed cartilage has much the same appearance as has the cartilage in "arthritis deformans." In other words, following the type of injury described in their experiments there is an actual regeneration of the destroyed tissues.

Now Ely believes from his experiments and from human material that the order of events in hypertrophic arthritis is, first, injury to the marrow, then follows aseptic necrosis in the *bone* below the joint and lastly the lipping about the joint. Axhausen has interpreted a final structural stage of the disease as the disease itself.

But ideal and experimental evidence is readily and abundantly at hand, found in the X-ray plates dealing with such conditions as Pott's' fracture and Colles fractures. Surely the normal alignment of these joints is always more or less disturbed. Again in the congenital deformities, namely: club foot and congenital dislocation of the hip, according to this static theory of etiology, the knee and hip on the affected side should give a hypertrophic arthritis. In the partial or complete ankylosis of any joint, such as occurs in tuberculosis of the hip or knee or ankle, the unaffected joints should show in time the hypertrophic changes. Scoliosis is a condition that obviously puts the joints of the spine under abnormal strain. And, finally, the deformities of rickets should be potent in producing this disease.

The following plates have been examined:

TABLE OF X-RAY PLATES

Case No.	Plate No.	Age	Diagnosis	Findings in associated joints
1	19182	Adult	Marked coxa vara both hips; posterior dislocation of the left hip	No hypertrophic arthritis
2	19594	Adult	Left hip coxa valga	No arthritis
3	16966	25	Old Pott's united with some internal bowing of the ankle and some roughening of lower articular surface of the tibia	No arthritis
4	57226	44	Colle's fracture with marked dorsal angulation of distal fragment and considerable callus formation	No arthritis of wrist bones or phalanges
5	31924	55	Scoliosis of lumbar spine, with convexity to left	Slight spurring about lumbar bodies
6			Tuberculosis of 4-5 lumbar spine. Bodies collapsed. 4 years duration.	No arthritis other vertebrae
7	16655		Old Pott's union of fibula internal malleolus displaced externally, not united. Also external displacement of the astragalus on the tibia.	Spur on the scaphoid
8	Adult	34	Pronated feet, knock knee	No arthritis spine, feet or knees
9	Private Case		Old dislocation terminal phalanx great toe	No arthritis other joints of feet
10		45	Congenital malformation spine	No arthritis
11	30280	35	Scoliosis with rotation of the body of the 4th lumbar to left	No arthritis
12	30195	36	Lumbar spine shows scoliosis with convexity to left; failure of union of spinous process of the last sacral segment	No arthritis
13	30913		Scoliosis with convexity to the right	No arthritis
14	30326	30	Scoliosis lumbar spine with convexity to left	No arthritis
15	31106	44	Scoliosis lumbar spine with convexity to left	No arthritis
16	30625	62	Scoliosis lumbar spine with convexity to right	No arthritis
17	30758	25	Scoliosis lumbar spine with convexity to right	No arthritis
18	31061	25	Lumbar scoliosis to the right	No arthritis
19	30259	40	Scoliosis dorsal spine with convexity to right	No arthritis
20			Tuberculosis 4-3 lumbar spine: fusion of bodies	No arthritis other vertebrae
21	31969	23	Marked scoliosis; double curve of the spine not secondary to bony defect	No arthritis
22	31924	55	Scoliosis of lumbar spine with convexity to the left	Slight spurring about lumbar bodies

23	25663	29	Destruction 4th and 5th lumbar bodies with marked list to right in lumbar region	No hypertrophic arthritis in other vertebrae
24			Scoliosis, right dorsal left lumbar curves	No arthritis
25			Tuberculosis ankylosis left hip joint	Right hip normal no hypertrophic arthritis
26			Right hip destruction of head; tuberculosis	Opposite hip joint normal
27		36	6th lumbar vertebra sacralized on right side	Remainder of spinal column normal

The percentage of cases with hypertrophic arthritis in which static strain is also present is 11 per cent. But this is practically the same as the percentage seen in all cases coming to this orthopedic clinic.

From another point of view this theory fails. I have seen a number of cases of hypertrophic arthritis in individuals whose posture is excellent, and who have never done hard work or subjected their joints to strain. These cases nearly always have bad teeth. In other words, the disease occurs where none of Preiser's etiological factors apply, and conversely, it may not appear where trauma strains are most potent.

Conclusion: Hypertrophic arthritis is not due to static strain.

OBSERVATIONS ON THE OPERATIVE TREATMENT OF SCOLIOSIS

BY ROYAL WHITMAN, M. D. NEW YORK

*These remarks apply primarily to a class of cases of fairly advanced scoliosis, in which backward projection of the ribs is the most noticeable element. The typical patient is a girl of sixteen or over, to whom the deformity has become a serious concern, and who is willing to undertake any form of treatment that will assure its reduction or concealment.

I think we are indebted to Dr. Abbott for the general recognition of the fact that deformity of the spine, as of any other part, can be cured only by over correction and by fixation for a sufficient time to permit the reconstructive changes that alone can assure stability. When, therefore, it had been demonstrated by a thorough and prolonged trial, that cure in this sense was as unattainable, in this class of cases by the Abbott as by any other method, a definite basis at least, for rational treatment was established. For even admitting that extreme distortion of the trunk by the Abbott method is, from the mechanical standpoint, the most effective method of lessening rotation of the spine, its manifest disadvantages as a means of partial correction, exclude it from practical consideration.

During the period of stagnation that followed this conclusion it occurred to me, in view of the objections to prolonged forward flexion of the trunk, that hyperextension and rotation might be tried, although Lovett's experiments had seemed to indicate that the spine was so locked in extension as to check rotation.

Assuming this to be true, it seemed that this attitude by relieving pressure on the vertebral bodies must at least lessen the resistance to correction of the lateral deviation.

At first extreme rotation was attempted by including the arm on the lower side, which was soon discontinued, but in a modified form the method in which the jacket is applied under lateral traction with as much hyperextension as possible, and cut in the usual

*Observations on the operative treatment of scoliosis. Presented at the Clinical Conference, Hospital for Ruptured & Crippled, May 18, 1921.

manner over the depressed areas, to permit expansion, has been employed since this time.[1] It would seem also from X-Ray evidence, that it is as effective in lessening rotation as is forward flexion, although the apparent correction as indicated by distortion of the trunk is, of course, much less.

Although this treatment, which increases the height and improves the appearance of the patient, is free from the greatest drawback of the Abbott method, all forms of corrective plaster support, applied for long periods have the disadvantage of compressing the thorax, inducing muscular atrophy, and in some instances irritation of the skin. This would be of slight importance if over correction and stability could be finally attained, but since this is impracticable, it is of advantage to supplement ambulatory correction by a period of fixation on a convex stretcher frame.

This position, as I pointed out many years ago, in advocating the convex frame in the routine treatment of Pott's disease in young children[2] exerts the most direct extending force on the spine, in the sense of separating the vertebral bodies, and it has the further advantage of increasing the lateral diameter of the chest. In the treatment of lateral curvature the pressure on the back tends to lessen the convexity of the ribs, to push them forward, and thus to expand the chest on the contracted side.

After a time ambulatory correction may be resumed, but preferably the final step is an operation for inducing ankylosis of the dorsal vertebrae, in order to assure the extended position, thus preventing flexion in this region which makes the deformity more apparent. By effacing the spinous processes one removes also the landmark from which lateral deviation is estimated, so that the immediate effect of the operation is an apparent considerable reduction of deformity. It would appear also, that the complete removal of the muscular attachments to the vertebral column should lessen its resistance somewhat, so that the deformity may be still further corrected by the subsequent fixation on the frame during the period of consolidation.

[1]The method was demonstrated at a meeting of the alumni of the Hospital for Ruptured & Crippled Dec. 28th, 1915. Am. J. Orth. Surg. Vol. 14 p 155.

[2]Trans. Amer. Orth. Assn.—Vol. 14, 1901.

The operation if confined to the dorsal region has the very great advantage that motion here being comparatively limited, its further restriction causes no inconvenience.

The operation that I favor is of the Forbes type, rather than the original Hibb's fusion, in which comparatively large sections of bone are pried up from the laminae, to bridge the intervals between them, and the spinous processes split into two or more segments, are flattened out laterally, to make a wide area for ankylosis. It is possible also, if the transverse processes were cut through on the convex side that the resistance to the corrective pressure of recumbency on the ribs might be still further lessened.

A fair degree of resistance to forward bending soon appears in the operated area, but recumbency is encouraged because of the corrective influence of pressure on the thorax, for as long a time as the patient will submit to it—usually for two months,—after which a short jacket to hold the trunk in the proper relation to the pelvis, is applied.

It is assumed that if the dorsal deformity is reduced, the lumbar deviation, which has been lessened by the treatment, may be eventually concealed by an ordinary corset.

It is, of course, evident that the preliminary reduction of deformity might be more rapid if the patient were placed on the frame in the beginning, or if recumbency were enforced in connection with the corrective jackets. There is however, the practical objection, that few patients of this class would submit to immediate and prolonged confinement who eventually accept it as a later step in treatment, and finally consent to operation to assure the correction that has been attained.

My interest in operative treatment was aroused by the discussion at the meeting of the Orthopaedic Association in 1920, and during the past year twelve patients have been operated upon in my service by members of the assistant staff and myself. The youngest patient was 13, the oldest 27 years, thus all were of an age in which the ankylosis of the dorsal region would cause no functional inconvenience nor developmental disturbance.

The time is too short to report final results, but the immediate effects have been very satisfactory to the patients, and the indications are that the improvement will be permanent.

It will appear that the purpose of the treatment in the cases reported is clearly defined, namely: to conceal deformity by effacing the most offensive manifestation, and to check its further progress. It seems to me that for the attainment of the object, the method of preliminary correction supplemented by the convex frame as a means of extending the spine, expanding the chest, and directly reducing deformity by postural pressure, has certain practical advantages over the routine in other clinics, and for this reason this preliminary report is presented.

Editorial

At a formal meeting in Boston June 4, 1921, to consider the report of the Editorial Committee, the American Orthopedic Association decided to return the Journal of Orthopedic Surgery to Boston for publication. A substantial fund was provided for the continuation and improvement of the Journal.

Any publication venture during the past few years has been difficult and even at times precarious. The present editor in presenting his final issue to the readers desires to thank all those who have helped to produce and who have been readers and friends of the Journal of Orthopedic Surgery during the past two years.

The Journal has now more than three times as many subscribers as it had about two years ago. It seems to be rendering a real service to the growing cause of Orthopedic and Reconstruction Surgery. This periodical as much as any other agency helps to carry on the torch which lights the way to relief for the patients in whom we are all so much interested.

For Dr. E. G. Brackett of Boston, the new editor, we bespeak the same friendly interest and hearty support which have meant so much to the retiring editor. H. WINNETT ORR.

The Editor and the Editorial Committee of the Journal have under consideration the possibility of changing the Journal from a monthly to a quarterly publication. The larger volume, issued at longer intervals, would give certain opportunities for preparation not possible in the monthly publication, and would probably afford a larger total amount of material during the year. The Committee would be grateful for the expression of opinion of the subscribers of their attitude toward such a possible change,—first, as to whether it would meet their approval; second, if not, as to their reasons for preference of the continuance of the monthly publication.

Please address communications to the Editor, Dr. E. G. Brackett, 166 Newbury Street, Boston, Mass.

The following resolutions were adopted at the Boston meeting:

The American Orthopaedic Association assembled in Annual Meeting pays mournful tribute to its charter member and beloved colleague, Arthur J. Gillette. A man of unexampled amiability, devoted to his profession as represented by its loftiest ideals, a worker of unremitting industry, a craftsman of highest skill, his passing leaves amongst us a void which we cannot adequately express in words. We desire to record our appreciation of his high value as a friend and colleague, our recognition of his work in establishing the first hospital for Crippled Children under State Control in the United States. We shall ever cherish his memory.

RESOLVED that the American Orthopaedic Association extends to the family of our deceased colleague their sincere sympathy and present to them this heartfelt tribute to a highly esteemed colleague.

The members of the American Orthopaedic Association desire to place on record their sense of loss in the death of Dr. Harry M. Sherman. For many years a faithful and devoted member of the Society he gave of his best to that as he did to everything with which he was associated—a skillful surgeon and teacher, a delightful companion, a loyal friend, his absence will be deeply felt. It is the desire of this Association that this resolution should be transmitted to his family with an expression of the sincerest sympathy in their loss.

Whereas God, in his infinite wisdom, has seen fit, on May 9, 1921, to take from our midst, Dr. Harry M. Sherman, our first President, and deprive us of his valued counsel, helpful friendship, and pleasant companionship;

Be it therefore resolved that we take this means of expressing our deep grief over the loss of a member noted for his high ideals, honesty of purpose, personal integrity, and constructive surgery and scientific attainments. He was a good husband, a kind father, a loyal friend and a scientific gentleman.

Be it further resolved that a copy of these resolutions be inscribed on our minutes and copies sent to his widow, and to the California State Medical Society, and the Journal of Orthopaedic Surgery.

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News Notes

Dr. O. L. Miller, who has for a number of years been practicing Orthopaedic Surgery in Atlanta, and associated with Dr. Michael Hoke in the Scottish Rite Hospital for Crippled Children, has moved to Gastonia, N. C., to be Orthopaedic Surgeon to the North Carolina Orthopaedic Hospital.

This hospital, with a capacity of sixty beds, has recently opened for the reception of its first patients.

In addition to his duties with the hospital, Dr. Miller will be in private practice in Gastonia.

Dr. H. Winnett Orr and Dr. James E. M. Thomson have formed a partnership for the practice of Orthopedic Surgery exclusively and will remove their offices to the First National Bank Building, Lincoln, Nebraska. Dr. E. E. Babcock is also associated with the firm.

Dr. Archer O'Reilly and Dr. C. A. Stone of St. Louis have removed their offices from the Metropolitan building to 3534 Washington Avenue.

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Current Orthopaedic Literature

Dislocation of the Sacro-Iliac Joint. By Alexander Gibson, M. A., M. B., Ch. B F. R. C. S., (Eng) F. R. S. E., Winnipeg, Manitoba. *Jour. A. M. A.*, Vol. 76, No. 22, May 28, 1921.

The sacro-iliac ligaments are so strong that it hardly seems possible that dislocation of the joint could occur; it would seem much more likely that violence sufficient to cause rupture of those ligaments would lead to rupture of the pelvis in preference, and in most cases would cause death. In cases of this injury which have been placed on record, the majority have been fatal or have been accompanied by fracture of the pelvis. Dislocation of the sacro-iliac joint has also been noted as a complication of diastasis at the symphysis pubis.

Case Report

An eight year old boy was hit by an express train in such a manner that the sacrum seemed driven forward of the left ilium without a fracture. Eighteen days following the injury the patient has recovered sufficiently to permit operation. A posterior curved incision was made, projecting portion of ilium removed with an electric saw, this portion wedged in as a graft between the sacrum and ilium. Recumbency in bed for two months wearing a pelvic binder. There was practically complete recovery.—*Leo C. Donnelly, Detroit.*

Nonoperative Treatment of Fractures of Cervical Vertebrae With Cord Injury. The Result in Four Cases. Michael Osnato, M. D., New York. *Jour. A. M. A.*, Vol. 76, No. 25, June 18, 1920.

Operative interference in a complete transverse crushing of the cord is useless and frequently harmful, but an operation may be urgently necessary if there is no complete transverse lesion. The difficulty is to determine whether there is a transverse crush or whether the symptoms are due to concussion of the cord or to an acute edema of the cord tissue.

There are undoubted cases on record in which some of the reflexes were preserved or where some of the reflexes returned in spite of the presence of complete lesion. In the majority of instances a complete motor paralysis and loss of sensation below the level of the injury with loss of all cutaneous and tendon reflexes and paralysis of the bladder and rectum, point to a spinal cord injury so serious that immediate operative interference is contraindicated. If the symptoms are due to spinal concussion in which considerable lengths of the cord are affected, a local operation will do little if any good, and it may do much harm.

If the symptoms are due to an incomplete crush or to compression of the cord, there will surely be some improvement within the first few days; then operative interference will offer much better chances of success.

When some motor, sensory or reflex power remains immediately after the trauma, and a complete motor and sensory paralysis later supervenes, operative interference should not be delayed, especially if compression of the cord by dislocated or fractured bone or by blood has been demonstrated.

After the decision to interfere surgically is arrived at one then immediately subjects his patient to the dangers of operation on the cervical cord, which are chiefly liable to cause edema and consequent interference with the functions of the vagus and phrenic nerves, namely respiratory and cardiac paralysis. Good functional recoveries occur most often after cervical injuries, as against injuries to other levels of the cord. The most frequent residuals are pareses in the extremities and atrophies in the small muscles of the hand, with stiffness in one or both of the lower limbs.

The loss of sensation accompanying such injuries often leaves only a scant residual disturbance. Root pains seem to be limited to one upper extremity.

Four cases are reported with undoubted cord injuries. From the neurologic findings the first case was probably a complete crush of the cervical cord, and resulted, as all these cases do, in death within a few months after injury. The other three cases were examples of partial involvement of the cervical cord, and all three of the patients recovered without operation.—*Leo C. Donnelly, Detroit.*

THE ROLE OF CANCELLOUS TISSUE IN HEALING BONE. T. Wingate Todd, F. R. C. S. (Eng.) *Ann. Surg.* 1920. Vol. 72, pp 453-466.

The paper contains a digest of observations made on about two hundred cases of chronic osteomyelitis, the result of wounds, in the Base Hospital Wolseley Barracks, London, Ont., in 1918. Most of these cases presented cavities in the long bones and therefore gave an excellent opportunity of studying the relation of cancellous tissue (or medulla) to healing bone without the complication of periosteal involvement. Various technical problems relating to effective treatment of such cases are dealt with in the body of the paper. The author's results regarding cancellous tissue are summarized in the following manner.

1. Cancellous tissue is one of the chief agents in regeneration of bone, and like the cambium layer of periosteum, should be treated at operation in the most conservative manner, consistent with thorough exploration and drainage.

2. In regeneration the cancellous tissue nearest the mid length of the bone grows most rapidly, whereas that in or near the articular extremities shows less readiness to proliferate and fill the cavity.

3. Septic bone cavities should be permitted to heal from the bottom, the wound in the soft tissues being kept widely open until this has occurred. The least possible mechanical disturbance of the cancellous tissue should be employed and no "disinfection" of the cavity attempted, for this simply kills the remaining tissue from which regeneration is expected.

4. Regenerating bone is very sensitive to and easily affected by pressure,

even of soft tissues, and by inefficient drainage. It is not adversely affected by the ambulatory method of treatment.

The work results practically in a restatement of principles laid down by Ollier but lest the reader's mind be diverted from the real significance of the paper, reference to the famous Duhamel-Haller controversy in any of its phases is avoided. In this case the work was carried out entirely upon man. Ollier's experiments were upon animals. Here one finds confirmation for man of Ollier's observations upon the osteogenetic power of the "marrow" in dogs. Again one finds the tube experiment of Ollier on the rabbit tibia reproduced and followed up in the long bones of Man. The essential lession of the work is that cancellous growth, though considerable, is delicate but that with proper care it can be encouraged and the cavity filled in a reasonable time with new bone after which, and not before, the soft tissues may be allowed to close.

NERVE SUTURE. Edwin M. Miller. *Archives of Surgery*, Jan., 1921. An experimental study to determine the strength of the suture line.

In the repair of peripheral nerve injuries it often becomes necessary to resect an extensive scar in order to reach healthy funiculi and considerable tension may be required to procure an end to end suture. The object of this experimental study was to determine the strength of the suture line at different periods after the anastomosis and to find out the relation between the size of a nerve and its tensile strength at the suture line. The sciatic nerve of dogs was used and two series of animals were run. In the *first*, sonsisting of eleven animals, a section of the sciatic was removed sufficiently long to require complete flexion of the leg on the thigh before end to end suture could be made. Some of the animals were allowed to use the limb as soon as desired. In others a plaster dressing was applied for different periods of time, varying from 11 days to 24 days. Study of these suture lines after autopsy showed a separation at the site of operation in only one instance. In the *second* series, consisting of eleven animals, end to end suture was made on the two main branches of the sciatic in the right leg and on the entire sciatic in the left leg, the diameters of those nerves varying approximately as 1:3:5. Determinations were then made of the strength of the suture lines at different periods after operation (from 1 week to 5 weeks) by the application of weights to a cord connected with the distal segment.

CONCLUSIONS

(1) In dogs, which show individual differences in rapidity of repair as do humans, the tensile strength of a suture line in the sciatic nerve or its branches is practically as great at the end of the third week as at the end of the 4th or 5th week.

(2) The strength of the suture line, especially after the 2nd week, is almost directly proportional to the diameter of the nerve.

(3) The epineural sutures of fine catgut or silk play little if any part in the strength of the suture line after the second week.

(4) Practical application. Long defects of nerves may be overcome by mobilization of the segments and change of posture with end to end suture. The suture line is apparently firm enough after three weeks to begin gradual straightening of the flexed forearm or leg. Clinically after operation upon the sciatic nerve, it would seem best to wait six or eight weeks after suture before extending the leg if flexion has been necessary to complete an end to end suture. In case of the median and ulnar extension of the forearm should not be attempted until after four weeks if flexion has been required.—*E. M. Miller.*

THE FALSE LOCALIZING SIGNS OF SPINAL CORD TUMOR. By Charles A. Elsberg, M. D., New York City. *Archives of Neurology and Psychiatry*, 1921, Vol. 5, page 64.

The author reports several cases of spinal cord tumors in which the level signs vary at different periods. He calls attention to the frequency with which patients with spinal tumors in the cervical region first complained of sensory and motor symptoms referable to the lower extremities, and states his belief that the fibers for the different extremities and perhaps even for parts of extremities are grouped together in the spinal pathways. Errors in interpretation of the signs referable to the side and part of the cord affected are possible, and the writer mentions explanations for these errors. Finally, the author discusses the explanation of paresthesia in the upper extremities caused by tumors in the thoracic cord and voices the belief that the upper extremity symptoms may be due to the effects of a column of cerebrospinal fluid above the tumor.

EPICONDYLITIS HUMERI. Louis Carp. *Surg., Gynec., and Obst.*, March, 1921.

Epicondylitis Humeri is a condition found in those engaged in heavy manual labor characterized by pain in the elbow region, functional impairment to a greater or lesser degree, persistent tenderness limited to the epicondyle of the humerus and extreme weakness of the forearm. Lifting with the hand in supination is possible with great difficulty, but almost impossible with the hand in pronation. There is no atrophy. X-ray examination shows no definite or constant changes. The average duration is about six weeks, but the condition may last several months with periods of intermission or remission. The symptoms may disappear gradually or suddenly. The etiology is doubtful. Influenza, strain, neuralgia, and trauma are possible etiological factors. An analogous syndrome may occur in the styloid process of the radius and the condyle of the femur. The best therapy seems to be immobilization and baking.—*Louis Carp.*

TREATMENT OF TUBERCULOSIS OF THE KNEE JOINT. By J. J. Kurlander, M. D. *Ohio State Medical Journal* January 1921.

Knee joint tuberculosis constitutes about 20 to 25 per cent of all cases of joint tuberculosis.

The disease may be primary either in the synovia or in the bone. Shaft tuberculosis is rare.

Knee joint tuberculosis must be differentiated from chronic synovities due to sprains, trauma or infection. Also from syphilitic joint affections, Sarcoma, carcinoma, etc.

In children there is a more marked resistance to the disease and reparative processes is much more active in children than in adults. For this reason, In children conservative treatment such as rest and immobilization are indicated.

Operative procedure hastens and insures a cure and is therefore indicated in adults.

The operation is that of resection of the knee. The author follows the technic of R. H. Hibbs in that only the cartilages of the articulating surfaces of the femur and tibia are removed. There is no attempt to excise or remove the capsule. The patella is excised sub-periostially and placed in a bed chiselled out in the femur and tibia, thus both immobilizing the bones and acting as a bone graft in one.

Immobilization in a plaster cast for three months at which time firm union is to be expected.—*J. J. Kurlander, M. D.*

Derangement of the Semi-lunar Cartilage. Louis Strahlmann, M. D., and J. W. White, M. D. *Journal of the A. M. A.*, February 26, 1921.

The authors analyze seventy-six operative cases of Semi-lunar Cartilage Derangements from the viewpoint of history, physical findings, surgical pathology, and end results.

In diagnosis, the localized pain and tenderness are particularly stressed, being present in the vast majority of cases, while locking is present in only about one-half of the cases. They believe simple hypermobile cartilage is a definite entity, more common than actual fracture of the cartilage, and that the external cartilage is involved in about one-fifth of the cases. Complete excision is considered the operation of choice and an early operative interference is advised. Careful analysis of end results in the unrelieved cases. (14%), shows that most untoward results are due to undetected syphilitic and tuberculous lesions, the deranged cartilage being only secondary. Results are also influenced by the involvement of other joint structures in the original trauma, the duration of the lesion, and the extent to which the cartilage has been excised.

Bilateral Forward Dislocation of the Fifth Cervical Vertebrae With Reduction by Manipulation. By Mitchell Langworthy, Spokane, Washington. *Journal of the American Medical Association*, February 12, 1921, Vol. 76, pp 447 and 448.

August 5th, 1920, a truck driver aged twenty-eight sustained an injury which forced his neck into extreme flexion. He was unconscious for a few minutes while being moved. Respiration was difficult and this was improved by traction on neck. Priapism, numbness and tingling in right hand and forearm and over entire left lower limb, frequent coughing with fresh blood

in sputum, and pain in neck, were the only symptoms. Lateral roentgenograms showed a bilateral forward dislocation of the fifth cervical vertebra on the sixth with a slight impaction of the body of the fifth. The fifth lay at least one-half inch anterior to the sixth. Reduction by manipulation was accomplished under anaesthesia five and a half hours after the injury, the roentgenogram showing perfect alignment. The method of Walton was followed which attempts to slip the articular facet, first of one side and then of the other back into position on the facets of the vertebra below. The neck and head were supported in plaster for six weeks. The symptoms gradually disappeared. He was up on the seventh day and discharged from the hospital on the fourteenth day, walking well with no discomfort. Examination at the end of the tenth week showed him to be perfectly well except for a slight soreness and stiffness at base of neck due probably to laceration of the ligamentum nuchae and the trapezius muscles. Movements of the neck were normal in extent although somewhat weak.—*Abstract by the Author.*

METHODS TO SECURE END-TO-END SUTURE OF PERIPHERAL NERVES. By Howard C. Naffziger, M. D. San Francisco. Department of Surgery, University of California Medical School. Abstract by the author.

End to end suture of peripheral nerves is the aim of the surgeon in those cases of nerve division which come to operation. When this is impossible "auto cable" grafts offer the next best prospect. In lesions of the large nerve trunks—ulnor, median, musculo spiral, the great sciatic and its internal and external popliteal divisions it is rare that end to end suture can not be obtained.

Of the methods found most useful in obtaining apposition of the divided nerve ends are:

1. Free mobilization of the proximal and distal portions of the nerve obtained by long incisions, identification of normal nerve above and below the point of injury, free dissection of nerve from sheath and when necessary lengthening of nerves to muscles by dissecting them from the main nerve trunk. This does not interefere with their function.

2. Transposition of the nerve to a shorter route than the normal one.

(a) Ulnar nerve—Transposition from behind the internal condyle to the flexor surface beneath the deep fascia and pronator radii teres without sacrifice of branches to the long ulnar flexors. Free the nerve well above the point of penetration of the internal inter muscular septum.

(b) Musculo-spiral nerve. Transposition to a position beneath the biceps and on the anterior surface of the humerus is used in extensive injuries to the posterior surface of the arm as well as to aid in overcoming nerve gaps. A high internal axillary incision and an incision on the outer surface of the lower third of the arm are used. The branches to the outer head of the triceps are sacrificed by this procedure.

(c) Median nerve—Dissection upward of the muscular branches and transposition to a more superficial position.

3. Favorable posture of the extremity to shorten the distance to be over come.

Ulnar—by flexion of wrist and elbow. Adduction and a forward position of the arm.

Musculo spiral—flexion at elbow, adduction and forward position of the arm with internal rotation.

Median—Wrist and elbow flexion. Adduction of arm.

Sciatic nerve—Extension of hip, slight abduction, full flexion of knee.

A method of exposing the entire sciatic by reflection of the gluteus maximus and permitting suture within the sciatic notch is given.

4. Gradual lengthening of the nerve by a two stage operation.

At the first operation by mobilization, transposition and favoring posture as much of the involved portion of the nerve as possible is resected and the ends sutured together. The extremity is gradually straightened over a period of about two months when a second stage operation permits resection of the remaining scar and end to end suture.

Interrupted fine silk sutures including only the neurilemma are used with no through and through sutures. Attempt is made to avoid rotation of the nerve by matching the intrinsic vessels of the nerves. Ringers solution and cotton sponges for freeing the nerve of clots are used. No foreign material or auto grafts of ttssue are used to protect the suture line. An attempt is made to have it lie between muscle planes.

After treatment. Removable splints are used to maintain desired postures with gradual extenston of joints. One or two months are allowed for lengthening the nerve. During this time massage and joint movements within the permissable range are practiced.

Length of nerve gaps overcome.

For the ulnar nerve by a combination of all methods outlined—10 cm.

For the musculo spiral nerve 10 cm; median 9 cm. Sciatic and its two matn divisions each 10 cm.

Larger gaps may be overcome by two stage operations. By the adoption of these methods nerve grafts are rarely necessary.

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The Journal *of* Orthopædic Surgery

REPORT OF COMMISSION ON CONGENITAL DISLOCATION OF THE HIP

BY JOEL E. GOLDTHWAIT, M.D., BOSTON.

The Commission appointed to consider the subject of the treatment of congenital dislocation of the hip desires to report progress and to request more time in which to complete its work.

Your Commission has made some progress in its study, but that which is presented at this time must be considered entirely in the nature of a preliminary report, since much more time will be necessary before the real significance of all the features of the investigation can be presented. The anatomic study, as far as it has been carried, is undoubtedly exact, but there is much that is yet to be completed, in order that the correct interpretation of these anatomic findings may be possible.

The vote which created the Commission reads, "To investigate the best method of reduction of congenital dislocation of the hip by a study of end results of at least three years' duration; these results to be collected in several large clinics for the Commission and observed by them, looking to a standardization of methods and the ... hich may occur following attempts at reduction."

... vident that the whole subject of Congenital Dislocation of the Hip is under discussion, since, while the best method of treatment is desired, this is to be decided by the study of the end results, and to analyze these fairly it is necessary to have a reasonably exact knowledge of underlying anatomic conditions. What we have a right to expect must depend to a considerable degree upon the structure of the joint at the time of treatment, and since one

finds such structure varying from what might be called normal (except for the displacement) to marked distortion or imperfect development of the bones, the results must vary accordingly.

Some of the differences in the anatomic structure in these conditions will be shown in the slides which will be presented, and an attempt is being made to see whether or not there is any constancy in these variations from normal which should influence the prognosis. Such information is essential before opinions as to results of treatment can be properly formed, and it is quite obvious from the literature on the subject, as well as from the differing opinions of those who have had reasonably large experience with such cases, that such information is very far today from what could be called exact.

The decision as to the best method of treatment is to be reached, according to the vote of the Association, by study of the end results. This is naturally in keeping with that which should be expected of an association of orthopaedic surgeons, since the thing for which we stand fundamentally is the test of function, or end results, and in this special subject your Commission is conscious that if its report is to be complete, it must judge the [illegible] a much longer basis than a three year [illegible] of these cases we should kn[illegible] [illegible], out thirty years or more, and we, [illegible] Association, should determine this and not have the information thrust upon us from outside. That we, as a body, are not able to speak with exactness upon this today is apparent from the different opinions held by theoretically equally good men.

In beginning its work, your Commission has first sought the opinion of the members of the Association, and on October 4th of last year a circular letter was sent out, from which a limited number of replies has been received. It is evident at once that we, as a body, are not in touch with our cases, so that it is possible for us to have more than indefinite impressions as to the real results of [illegible] Histories are incomplete, x-rays were not taken, or hav[illegible] stroyed, subsequent examinations have not been made [illegible] records entered, etc., so that it is impossible to pass fair judgment upon such work.

Several of the members have sent in reports of carefully prepared cases. These have been studied. Others have been sent in that are lacking in many of the details desired by the Commission, but which

have some value in certain phases of such a study and are being used as much as is possible.

The Commission has visited several of the Eastern clinics this year, with the expectation of extending its study to the other sections during the coming year, if that is desired by the Association.

A most carefully prepared group of forty-nine cases was examined at the New York Orthopaedic Hospital and Dispensary, and we are indebted to Dr. Hibbs, not a member of this Association, for the time, interest, and courtesy shown by him and his entire staff in the study.

A group of eight cases from the Johns Hopkins Hospital was studied at Baltimore, through the kindness and interest of Drs. Baer and Bennett.

At the Children's Hospital, Boston, twenty cases were actually examined, while the radiographs before and after of an added sixty-two cases were studied, the work being directed by Dr. Soutter.

From the Massachusetts General Hospital, eighteen cases were studied, representing the work of the Orthopaedic Department of that Hospital.

Attempts have been made to see cases in other of the Eastern clinics, but for one reason or another such opportunity has not been possible.

To form an opinion of the best methods of treatment in such cases is naturally not easy, unless other observers or clinics are willing to submit their work for analysis.

The statistical study, as far as the work has been carried, will be presented by Dr. Adams, and the lantern slides which are offered as suggestive evidence at this time will be presented by Dr. Willard. From the former, suggestive conclusions may be drawn, but nothing definite can be stated that would represent our final opinion until other groups of cases have been studied. From the latter it will be seen that very few of the hips are normal in their bony form, either before treatment or after treatment. An anatomic normal is rarely seen: nevertheless, from the point of view of function many of the cases are normal. How far these two features depart is surprising.

The anatomic structure with reference to replacement and with reference to its permanence is suggested. The relatively vertical or the widely oblique axis of the innominate bones certainly has some importance in the function of some of the hips. The depth of acetabulum, the prominence especially of the upper shelf, is of suggestive importance as to late prognosis. The axis of the neck, both vertically

and anterior-posteriorly, is of wide significance. The shape of the neck of the femur varies greatly, and while no real conclusions can be drawn from this at the time, it, nevertheless, is strongly suggested that the long slender neck rarely stands the strain of treatment and usually shows later with much shortening and distortion.

The inclination of the axis of the epiphyseal cartilage joining the head of the femur is apparently of much importance in the final result. The cases in regard to this feature group themselves under three types: one, with the axis nearly horizontal, the lower border of the neck of the femur projecting inward, so that it must be well within the joint and completely underlying the epiphysis; two, with the axis oblique, the diaphysis being largely without the joint and nothing to hold the epiphysis in place in its relation to the neck of the bone other than the strength of the cartilage itself; and three, the crescentic form convex upward, so that the epiphysis fits on to the neck of the bone as a cup.

The change in the development of the bone from that which existed before treatment and that which exists after treatment offer very suggestive matters of reflection upon which as yet the Commission does not wish to submit a final opinion, but enough has been shown to lead us to warn all who have the care of such cases to use the least amount of violence that is possible in whatever treatment is considered necessary, since the capital epiphysis of the femur, like any other similar bone structure, may be very easily damaged, with resulting serious interference with its development.

In the slides which are presented the selection has been made in order to show first the widely differing conditions present in these cases, and secondly some of the conditions as they exist after treatment is ordinarily completed. One slide is presented to show a case long after ordinary care with one hip still unreduced, with much disability, and with the other hip, which was never displaced but which had some of the anatomic features seen so commonly in these cases, which must mean strain with use. The disability in this imperfectly formed, but never actually displaced, hip is greater than in the dislocated one. The anatomic appearance of some of the hips here shown suggests the possibility of strain with resulting irritative thickening, with a similar end result.

Your Commission regrets that it is not able to report more fully at this time, but is ready to continue the work if it is desired, and hopes that the members of our Association understand enough of the difficulties of the problem to enable them to have patience with its

representatives. It wishes to express its appreciation to all who have assisted by offering cases for study, and trusts that the Association appreciates enough of the effort which this represents to be genuinely grateful to them.

STATISTICAL REPORT OF THE COMMISSION ON CONGENITAL DISLOCATION OF THE HIP, FOR 1921.

BY Z. B. ADAMS, M.D., BOSTON.

THE COMMISSION wishes to thank the members of the American Orthopedic Association for their kind coöperation in this work on congenital dislocation of the hip. We hope that it will stimulate the members to the keeping of more complete and careful data on just what was done in each case, and to the following of the cases from the time of reduction until the ultimate end-result is obtained—so that we may improve our methods of treatment and after-care.

The Commission would welcome any suggestions as to improving their card for recording the cases.

STATISTICS.

As to sex, 1056 cases were collected, of which number 116 were boys and 940 were girls. As to hips dislocated, 713 cases were collected for study (474 Denucé and Papin); 201 were right (115 Denucé); 288 were left (108 Denucé); and both were out in 224 cases (251 Denuce). See Denucé.

The presence or absence of other congenital defects was recorded in 234 cases, and found in 14 of that number as follows: spina bifida, spina bifida occulta, absence of tibia, genu recurvatum, pes equinovarus, pes valgus, idiocy, etc. Some of these hips showed extreme defects before reduction, but the results in general were satisfactory. Seven were in, one was questionable, five were out, and two were

anterior. Good function was recorded in six, fair function in three, poor function in four, and one was questioned in regard to function.

Although inheritance is infrequent—194 cases recording only seven instances where dislocated hips existed in some other member of the family—the condition seems to occur more frequently in certain races. In southwestern France—the Basque country— with a population of less than five millions of people, 875 hips have been reduced in one clinic at Bordeaux since August, 1914, while in the two largest orthopedic hospitals in New York City, which are surrounded by a population of approximately fourteen millions of people, only 535 hips have been reduced during the same period of time. Furthermore, we are told that congenital dislocation of the hip is not common among the negroes. Dr. Baer, in Baltimore, says that the proportion is about one colored child in thirty children with congenital dislocation of the hip.

Fully realizing that the soft parts, *i.e.*, the muscles and their tendons, the capsule and ligaments, the joint and bone cartilages which do not show in radiographs, may play an important rôle in the difficulties of reduction, a study of the radiographs of the hips before reduction has been attempted—with a view to determining the best method of treatment and the ultimate prognosis as to final result. Of the 102 hips thus studied, 71 showed torsion. Small, osseous centres in the capital epiphyses were noted in 60; this centre was imperfect in 2, missing in 3, and good in 21. A shallow socket was noted in 13, a poor shelf in 17, and a fair shelf in 30.

These pre-operative defects, with the exception of torsion, seem to have but little effect upon the result.

METHODS USED IN REDUCTION.

Ridlon's method, 348; Lorenz's method, 150—of which Lorenz himself did 38 while in this country; open method 12, one of these by Hoffa himself; manual, 155 (?)—many of these Ridlon's method; Bradford machine, 80; Hibbs table, 80; and preliminary osteotomy was done on 11 femora. These figures include the replacements as well as the first operations. The Commission would like to have recorded, also, whether the cases were reduced easily or with difficulty, whether or not much force was used, and whether the hip went into a good acetabulum or not. Upon these facts, which we believe to be of importance, almost no data has been returned.

The machine and Hibbs table methods may be used gently, although these methods usually mean force; hips may be broken by manual manipulation.

It was suggested in my paper of last year that many of these deformed heads resembled Calvé-Legg's disease and might be due to trauma.

POSITION.

Lorenz position was used after 188 reductions, Lange position after 140, mid-position after 7, Schlessinger position after 2, and Worndorf after 1. It was our hope to be able to report the influence upon torsion of these positions, but there have been too few radiographs submitted to allow any such study. However, torsion is found after Lorenz's position, as well as after Lange's position.

The length of time after reduction the patients remained in the primary position and plaster varies greatly. In some clinics the plaster is changed routinely at the end of one month; in others, the hip remains in the primary position and plaster for four or more months. In a few, this first plaster is continued for eight months, all plaster below the knee being taken off at the end of four months. Plaster is the only method of holding of which we have any records, although I am told that some operators employ a splint. The plasters, in some reports, are described as spicas; in a very few others, we are told that they extended from the ribs or the waist to the knee, below the knee, to the ankle, or to the toes. In general, but little attention was paid to this query, and no statistics can be given for comparison.

We believe this matter may be of importance, and may be the cause of some of the deformities noted, and the cause of lost function. We should like to know how long the plaster was left capping the knee—thus bringing pressure on the superior femoral epiphysis—but this fact was not supplied in answering our questions. In short, the details have not been supplied. Some sort of spica was continued, in general, on an average of from seven to ten months,—the time varying in inverse ratio to the age of the child.

The children walk in from two to ten months. In some clinics, they are encouraged to walk early in plaster. In other clinics, no walking is done until after the plaster is taken off. In still other clinics, it is the practice—after a considerable period of recumbency—to allow the child to walk, wearing a plaster spica. But here again, the data is not accurate enough to allow of any report. It is thought that this small detail may influence the results—especially when the child is

gotten on its feet soon after the removal of the plaster, when it has been held for a number of months, or when it is gotten on its feet, wearing a heavy plaster, after months of recumbency and the accompanying atrophy.

As to post-operative treatment, the data returned is so scanty that no report can yet be made. If it is the routine to give active and passive exercises, nothing is said about it. Limbering exercises were recorded in a few cases, but no notes of their character, or success were given; yet this may be a very important period in the treatment, as regards deforming or shaping the head softened by long holding in the plaster.

RADIOGRAPHS.

The changes which are so commonly found by a radiographic study of these hips are not due to rickets, for this condition was noted only four times in the 209 cases studied. They may be due to congenital defects in the head and acetabulum, which may or may not have caused the dislocation. Some of these hips, occurring with other congenital defects, give as good results as the general case under our treatment. Are all of these defects purely congenital?

Some of the changes, such as fracture of the neck, are due to known violence. Is it not possible that the cartilaginous head may be crushed by force used in reduction, or that stretching and pulling the capsule may destroy the circulation in part of the head and neck? Is it not also possible that the weight bearing too soon after long confinement in plaster may crush the softened head?

RESULTS.

For analysis, the cases were divided into those over six and those under six years of age. Of the children *six years of age and over*, there were 46 cases, 14 of which are double (60 hips); 70 operations and replacements; 24 hips are in, 29 are out, 1 is marginal, and 6 are questionable. Of the 14 double cases—three cases done by machine have one hip in and one hip out; another case has both hips in, but one head gone. Done on the Hibbs table, one case, six years of age, has both hips in, with fair function; there is one case in which both hips are questionable, and one case in which one hip is in and one hip is questionable. Of those done by Dr. Stern's method,—he reports one case, 11 years of age, in which both hips are in, with good function; also one case in which one hip is in and one hip is out. In all the other double cases—five in number—both hips are out. Of the single hips, two right ones are out, and five left ones,—making a total of seven failures out of thirty-two single cases.

	CASES	HIPS	MAN.	MACH.	H.T.	LOR.	OP.	OUT	IN	MAR.	ANT.	?	GOOD	FAIR	POOR	?
J.H.	8	12	12					2	10				3	2	3	
C.H.	59	76	124	63			1	13	54	9		13	29	17	8	2
MGH	18	25	14	2			5	4	20	1			7	14	5	
Hibbs	49	63	13		85	1	1	16	47				23	22	4	
Stern	74	91	109				1	19	71				54	7	13	
Freiberg	8	9	9						7	2			4	4		
Hodgdon	1	2	2						2				1 CURED			
Mayo	42	58	12		45		1	16	26	9		5	19	7	11	5
Steindler	15	19	19					3	11		1	4	7	2	6	
Campbell	3	3							3							
Brackett	9	12	14				4	5	5	1	1		2	2	4	
	286	370	228	65	130	1	13	78	256	22	2	12	149	67	54	7
Ridlon + others	439	412	446						152		32	14	42			

COMMISSION EXAMINED 8 BALT. + 49 N.Y. + 29 C H = 86 CASES 113 HIPS
NORMAL MOTION IN 14 RED. HIPS

CASE	SEX	AGE	DATE	HIPS		X-RAY	Rx	POSITION	HELD	1st CHANGE	WALK	IN PLASTER	MASS	X-RAY	MOTION	SHORT	RESULT
7 MW	♀	2	1915	BOTH	NO	NONE	MANIP	LANGÉ	LONG D SPICA	1 MOS	4 MOS	6 MOS	L	F IN R F IN R	NOR NOR		G
5 SL	♀	3	1918	LT	RICKETS	ST P	HT 1 FAIL	"	S	"		3"	L	T FRIN P	NOR		G
17 ML	♀	4	1903	LT	NO.	NONE	MANIP	"	S	"		5"	NO	T IN	NOR		G
5 MA	♀	3½	1918	RT	CONGEN.	SDT P	HT 1 FAIL	"	"	"	1 MOS	6"	NO	IF INRF	NOR	¼"	G
16 10C	♀	2	1906	LT	DEF.	S P	MANIP	"	"	"	?	9"		N IN N	NOR		G
12 AM	♀	2	1910	RT	NO	S G	HT	"	"	"		5"	L	GVIN	NOR		G
6½ BH	♀	3	1917	RT	PREVIOUS	SVT G	MANIP 1 FAIL HT	"	"	?		4"	L	T SVIN G	NOR		G
15 AV	♀	2	1907	BOTH	Rx	ST F ST F	MANIP MANIP OSTIOT	"	D	"		6"		N IN G NC OUT F	NOR LAX		G
8 JOH	♂	2	1914	LT		ST P	HT	"	SPICA	"		7"		GT IN R	NOR	½"	G
8 LF	♀	3	1912	RT		NONE	MACH	?	"	"	3"	3"		NONE	NOR		G
6 DW	♀	2⅓	1915	BOTH		NONE	MANUAL MANUAL	LORENZ	D		10"	16"	L	F IN G	NOR		G
7½ AP	♀	4½	1917	LT		ST SP	MANUAL	"			9"	9"		N IN ? N	ROT. IN -	¾"	F LIMP
6¾ FTC	♂	2¾	1917	BOTH		NONE	MACH MACH	MID	D	?	?	?		T IN RF N IN RF	ROT. OUTS 5° IND HYPER 10° LT NOR	¼"	F TIRES
20 HH	♂	2½	1913	BOTH		S S	MACH	LANGÉ	SPICA	5"	10"	6-8"	L	N IN R F IN R	NOR LIMITED	L ½"	F LIMP

F = FLAT   NS = NECK SHORT   V = COXA VARA

Deformities in Radiographs

		Before									After							
B Hips	Clinic	A	T	G	S	SS	P	F	G	N	G	D	T	N	R	G	F	P
5	E	4	5	2	2	1	3	2				4	4		4	1	1	2
33	N	43	24	4	29		19	9	5	4	4	35	24	N	23	9	8	12
8	B	9	3	4	4		1	6	1			9	5			3	4	2
12	M	21	12	4	8		3	2	5		1	18	8		9	14	2	5
2	H	2	2					2				2			2	2		
7	F	10	6	2	5		3	3	1	1		8	7	N	1	4	4	2
3	C	3	3		3		1	1	1			3	1		1		1	2
	S	8								1		7	5		4	6	2	
34	H	62	16	1	18	4	25	5	4	6	5	51	23		6	21	16	17
104		162	71	21	60	5	55	30	17	12	10	137	77		50	60	38	42

HEADS

G = Good = 21
S = Small = 60

SS = Imperfct = 5
T = Torsion = 71

N = Normal = 12
D = Deformed = 137

Good = 10
T = Torsion = 77

ACETABULA

G = Good = 17
F = Fair = 30

P = Poor = 55

G = Good Shelf = 60
F = Fair " = 38
P = Poor " = 42

R = Rough = 50
N = Norml = 2

Ridlon's records show that 110 cases—31 doubles—(141 hips), *six years of age and over*, were treated by him and other surgeons. One hundred and forty-one operations and re-operations were done by Ridlon, Lorenz, and others: 30 hips were reduced; 11 were failures; 12 are anterior; 21 single hips are out and short. Fourteen double hips were attempted and resulted as follows: one case with one hip in, and one anterior; ten cases with one hip in and one hip out; three cases with both hips out. Three fractures were recorded. The final total results in children over six years of age are 201 hips, 219 operations, and 54 hips in.

Of the children *under six years of age*, there were 250 hips (195 cases; 55 double, 311 operations performed with the following results: 198 hips were in, 34 were out, 12 were marginal, 4 were anterior, and 2 were questionable. There is good function in 118 hips, fair function in 48, poor function in 26, and questionable function in 3. These include the 55 doubles. Of the latter, 40 cases have both hips in, six cases have one hip in and one hip out, three cases have one hip in and one hip anterior, and six cases have both hips out. Of the single hips out, seven were right and six were left—making a total of 13. Reports on 36 of these 195 cases were made very soon after the plaster was removed and hence are not, perhaps, reliable.

Ridlon adds a record of 271 hips—219 cases—62 double—*under six years of age*, with 305 operations and replacements being done by him and others. Of these hips, 122 are reduced, 59 are out, 10 are marginal, and 25 are anterior. Of the 62 doubles, 15 cases have both hips in, 17 cases have one hip in and one hip out, 9 cases have one hip in and one hip anterior, and 7 cases have both hips out. Of the single hips out, 9 are right and 26 are left. This makes a grand total of 722 hips, with 835 operations, and 374 hips in.

Now, Gentlemen, we must compare these results with those reported by M. Le Docteur Edouard Papin, of Bordeaux, who reports in a recent article on 725 hips done since August, 1914. They have reduced every hip with only 11 re-dislocations, and of these re-dislocations, nine were re-reduced. He uses the simple manual method of M. le Professeur Denucé, and puts much emphasis upon the fact that no force ever is used in the reduction.

ATROPHY AND SHORTENING.

Atrophy is noted as present in a good many thighs and legs which anatomically are reduced, and have been reduced for a number of years. Shortening is present in a good many of the reduced cases—even in some where the heads are very good, but it is not always accompanied by atrophy.

TRENDELENBURG.

The presence or absence of a Trendelenburg sign has been studied in some cases. It is found present in cases that are anatomically reduced, where the glutaeus medius muscle is weak, as it is in some of the cases. There is not yet enough data to give any figures. These children limp. And gain, Trendelenburg's sign is absent in certain cases which are out by radiographic evidence, but where the muscles are strong, and the child has learned to incline the body a little to the affected side.

Chart 4 shows 14 hips with normal motion found in the examination of 113 hips. All others showed certain limitations of motion, the most frequent being increase of outward rotation and diminution of inward rotation.

LESSONS FROM MY EXPERIENCE WITH CONGENITAL DISLOCATION AT THE HIPS.

BY JOHN RIDLON, M.D., CHICAGO.

In 1885, Dr. Buckminster Brown of Boston, reported (*Boston Medical and Surgical Journal*, 1885, No. 23) a case of bilateral congenital dislocation of the hips treated by traction, and cured. The cure, however, proved to be a delusion. Dr. Brown did not know whether the hips were replaced or not.

Trusting in Dr. Brown's report, I treated a unilateral case by traction, believed that I had replaced the hip, and reported the case in the *New York Medical Record*, November 16, 1889. I know now that I never replaced the hip at all. I have record of two other New York cases—one unilateral and one bilateral. The unilateral case was the first anterior dislocation reported. These cases were not treated.

Treatment by traction after the method of Buckminster Brown, or by traction splint, as I did prior to 1892, and as is still being done by some advertising orthopaedists and orthopaedic institutions, is absurd and always results in failure.

In June, 1892, I came to Chicago, and from that time to December, 1900, I attempted to replace dislocated hips by the following method: "The leg was pulled by assistants against the resistance from a towel through the crotch held by the operator as a preliminary stretching. Then the operator stood at the side of the patient away from the dislocated hip, flexed the thigh on the pelvis, wound his arm around the thigh from the front to the outer side, back and inner side and outwards across the groin. Grasping it thus, he adducts, flexes and lifts the head of the femur towards the acetabulum, and rotates it from side to side while he holds the pelvis down with the other hand." (Ridlon and Jones, 1899.) Obviously, only a very easily reducible hip could be reduced in that way.

The state of knowledge in this country late in 1900 may be understood by the following notes made by me when, with the mother of a 4-year-old girl with bilateral congenital dislocation of the hips, we consulted the three then most eminent orthopedic surgeons in New York City and received the following advice:

Dr. Shaffer advised Bradford's operation at about the age of five years. If the bloodless operation relapsed, do an open operation. If that relapsed, use the traction splint with surcingle about the hips. The best result in unilateral cases is one inch shortening.

Dr. Gibney advised the bloodless method—one hip at a time. The child to walk after one week; but very little. Operate on the other hip two or three weeks later. Put in plaster splint with 120 degrees to 130 degrees abduction, rotated inwardly. Leave it so for six weeks; then rotate it a little and put on a short spica. Put felt back of the trochanters. After two or three months, put on a brace like Whitman's and use massage and passive movements. Suffer relapse three or four times before resorting to an open operation. Use traction splint if necessary, after failure.

Dr. Whitman said he had 25% successful in unilateral cases. He advised stretching by hand, and abduction to nearly a right angle. Put up rotated inward. He said relapses usually are forward. He said there should be no stiffness by the bloodless method; none by the open method unless the socket is scraped out. He tried bloodless replacement but once.

In the autumn of 1900 Dr. Bradford kindly loaned me Lorenz's new book, and from that time on I attempted to follow his method, using a specially built table with a post between the patient's legs plugged into the table for a fixed point of counter-traction, and a

wedge-block plugged into the table for a fulcrum to pry the femoral head into the socket.

Lorenz should not be credited with originating the "bloodless" method of successfully replacing congenitally dislocated hips. To Paci of Pisa belongs the credit. Lorenz learned the "bloodless" method from Paci at the International Medical Congress in Rome in 1894, and published his book in 1895. (See paper by Dr. G. G. Davis, *American Medicine*, August 29, 1903.)

Lorenz's method, modified from that of Paci, as demonstrated in this country in 1902-3 was as follows: The patient being fully anaesthetized, the capsule was stretched by fully flexing the straight leg until the foot was beside the ear, then strongly carrying the leg backwards, and from side to side; then a sheet folded obliquely was passed between the legs and fastened to the head of the table, the perineum being protected with a rubber pad and two or three assistants pulled on the leg, each bracing a foot against the table. When the stretching was deemed sufficient, the flexed knee was grasped by the operator, the thigh flexed to a right angle and abducted, the tense adductor muscles hacked off with the edge of the operator's hand, and the thigh strongly abducted over a wedge-block used as a fulcrum below (back of) the neck of the femur, while the opposite side of the pelvis was held down by an assistant.

The Lorenz operation is unnecessarily difficult and dangerous. Stretching the capsule by extreme bending of the thigh in all directions and strong traction of the limb as a preliminary to replacement, and abducting the thigh from right-angled flexion over a wedge-block while the adductor muscles are hacked off by the edge of the operator's hand, resulted in not a few fractures of the neck of the femur and several cases of paralysis. Even death has resulted. Hacking off the abductor muscles removes an important support to the replaced head, and has caused many "anterior transpositions."

On March 3, 1904, I reported to the New York Academy of Medicine (*Jour. Am. Med. Assoc.*, April 16 and 23, 1904) on the result of Lorenz's operations and my own cases up to that time. Soon after this report, Mr. Ralph W. Bartlett, a Boston lawyer, wrote me that he thought that all uncured cases could be cured by the use of his machine. I invited him to come to Chicago and try, and he accepted the invitation. In the *Chicago Medical Recorder* for September, 1905 I reported the results in Chicago with the Bartlett machine—four unilateral and three bilateral cases—and said as follows: "A year ago I reported on the results of 94 congenitally dislocated hips operated by

the manipulation method. Twenty-nine were replaced by Lorenz and 65 by me. I expressed the opinion at that time that the number of anatomical replacements from this method would not be more than 10% to 20%; that the number of failures in selected cases should not be more than 20%; and the remaining 60% to 70% should be what are called "good" results by Lorenz, and included all those cases where, despite the fact that a normal anatomical replacement does not result, the patient stands straighter and walks better than before the operation, the anatomical relations being such that the patient may be expected to gradually improve with the passing of years instead of gradually growing worse, as is the case in unoperated patients."

The use of Bartlett's (patented) machine and the Bradford machine is based on the mistaken theory that when traction is made on the limb the dislocated head passes downwards and back of the socket and can be pried in by a lever from behind; whereas it is only those more backwards than forwards of the middle of the socket that go that way. Further, pulling with the leg abducted pulls against the stretched adductor muscles, while pulling with the leg adducted, to relax the adductors, hooks the head against the rim of the socket, if there be any upper rim. All these bloodless methods, and all others that I know of, are executed without any attempt by the operator to determine at any stage of the manœuvre in just what relation the head really is to the socket. The plea I make for my operation is that the head is put in in the easiest way, with the least possible damage, and with positive knowledge at each step of the relation of the moving head to the fixed socket into which one attempts to put it.

Dr. Z. B. Adams, in his unpublished paper, "Analysis of the End Results of 32 Cases of Congenital Dislocation of the Hip, Comprising 42 Hip Joints," read at the last meeting of the Association in Toronto, seems to me to be even more pessimistic than I was 17 years ago. Apparently, Boston is still in the 1905 stage of development in the treatment of congenital dislocation of the hips. Adams's cases are divided into those over six years of age and those under that age. Of the 16 cases over six years of age—19 hips—all were out. One, a girl of 6½ years, was said to be anterior with two inches shortening, which is considerably more shortening than I have seen with a true anterior transposition. At least eight of these cases ought never to have been attempted, as they were from 13 to 16 years old. There were 16 cases—23 hips—under six years of age. Of these, it is said that there are 13 hips in, 2 anterior, 1 ankylosed and 7 out. This means that of the cases under six years, taking both

unilateral and bilateral cases together, over 60% were in. But the division of the cases at six years, without considering the shortening (which is not stated) is arbitrary. Taking all the cases together, there are over 30% in. My remembrance of the paper was that Dr. Adams claimed only 10% in; but I find no such statement in his paper which he recently kindly let me read. His conclusions are:

"I. Congenital dislocation of the hip cannot be successfully reduced after the child is six years old.

"II. That after reduction, the hips should be put in plaster, preferably in the Lange position, *i.e.* (flexion 90 degrees, abduction 90 degrees, inward rotation), flexion to right angle or more, abduction to 90 degrees from the saggital plane of the body, and inward rotation of the thigh with the knee flexed to a right angle. This brings the foot in the right plane for walking when the flexion is reduced at the end of treatment.

"III. Even with unilateral dislocation, both legs should be included in the plaster, which should extend below the knees on both sides—the two legs being placed in similar position. It is best to have the plaster extend from the toes to the waistline.

"IV. The plaster should, if possible, be left on for eight months or more, or, if changed, should only be changed at long intervals. By this method, the growth of the femur in length at the lower femoral epiphysis forces the head of the femur into the acetabulum and compresses the pelvis laterally, thus folding the os innominata in, and deepening the acetabulum.

"V. Perfect functional hips are obtained after reduction of congenital dislocation, but they are not anatomically perfect, as found by x-rays."

That progress has been slow is not surprising since everyone tries to replace every hip that comes to his hand. When Bradford did practically all the hips in Boston, Whitman in New York, and I in Chicago, we each had enough cases to learn something and make some progress. If your Committee that has this subject in hand gains enough evidence to standardize the selection of cases, the manoeuvre to be practised to replace a hip, and the after-treatment, and settles the question as to what cases, if any, should be subjected to a cutting operation, it will be of greater benefit than finding whether the percentage of retained hips is 10 or 80.

In the discussion following the reading of Dr. Adams's paper, I said that in properly selected cases the percentage of retained hips ought

to be 50 for bilateral cases, 50 for anterior dislocations, 75 for superior dislocations, and 100 for posterior dislocations. Several members immediately noted down these figures with questioning glances. Hence this paper.

I have made an earnest endeavor to learn what the results are in the cases with which I have had to do. In my private files I have the names and addresses of 437 cases. I have written to all in which the final result is not already known. Many letters have been returned, marked, "Not found," but I still have a creditable number of cases—about half as many as I thought I had.

For over sixteen years I served on the staff of Wesley Hospital, and it was there that Lorenz did most of his work after he returned from California; but the histories of all patients in the hospital during that time are said to have been burned. I served for a like period at Mercy Hospital, and no records are available there. I served for over ten years at St. Luke's Hospital. The records there are stored in such confusion that they say it takes a day to find the record of one case, so I have made no effort to trace my cases there. I served for twenty years on the staff of the Evanston (Ill.) Hospital. No records are available from there. For over twenty years I did all the congenital hip operations at the Home for Destitute Crippled Children, but the histories are not cross-indexed, and my assistant, Dr. Berkheiser, was able to find only twenty-four with my name on them, among some 12,000 histories that he looked through. Later, the Superintendent found a few more. From the annual reports there appear to have been at least fifty cases. I have operated from Boston to San Francisco, but many of the cases cannot be traced. In June, 1914, I operated on a case at the Massachusetts General Hospital, but after a year Dr. Adams was unable to trace the case, and the final result is not known. The one done at the Children's Hospital for Dr. Bradford cannot be traced. I operated on two cases for Dr. Hibbs at the New York Orthopedic Hospital. In one case I broke the femur. That case is well remembered, and every man from Chicago who has visited the hospital since then has been told of it; the other case was a bilateral one upon which, two months before, Hibbs had done an osteotomy of the femora, with twisting. He replaced the right hip, using his table. I replaced the other without fixation on his table. Both hips were in four years later. I operated on one case for Dr. Townsend at the Hospital for the Ruptured and Crippled; but the case cannot be traced. I operated at Jefferson for Dr. Wilson, but have a record of only one case; and in that the result is not known. I operated at

Rochester, N. Y., for Dr. Prince. The hip is in. At Pittsburgh, I operated for Dr. Silver. The hip slipped out. Dr. Wallace put it in again, and it has remained in. I operated at the Lakeside Hospital in Cleveland, for Dr. Morrill. The child died before the result was known. I operated on several for Dr. Gillette. The result is known in some and in some it is not known. I operated for Dr. Geist before the Central States Orthopedic Club, some time before the war. In 1920, the hip was still in. I operated for Dr. Packard at the Children's Hospital, Denver. The child died before the result was known. I replaced two hips for Dr. Sherman at the Children's Hospital, San Francisco (bilateral case), and Dr. Sherman reported the result as perfect five years later. It is therefore obvious that I am not reporting the final results in all the cases I have operated on.

From June, 1892, to the advent of Lorenz on October 12, 1902, I have record of 55 cases: 6 males and 49 females, with 12 right and 27 left hips, and 16 bilateral—71 hips. Of these 55 cases, I examined but did not treat 38. Some were rejected, some refused operation, and some did not return. In four cases I failed to replace the hips. In two the result is not known. Four unilateral hips are in; and four relapsed; one bilateral case has both hips in, and two have only one hip in, the right in in one case and the left in another—a total of eight hips in and six out. An unknown number of my cases, both failures and those not treated, went to Lorenz.

Of Lorenz's cases I have notes on 16 rejected, 5 failures, result unknown in 3 cases. 2 unilateral hips are in, 16 are out. In one of my bilateral cases with the left hip in and the right out, he replaced the right hip in 1902 and again in 1903, but the patient still limps and it is evident that the "Lorenz leg" is shorter than the "Ridlon leg." A bilateral case that had relapsed from my operation he replaced—both hips. The left hip remained in place but was very stiff; the right hip relapsed. Two other bilateral cases had both hips relapse. In one unilateral case that he thought could be replaced, the operation was done by another surgeon; but in 1921, the father wrote me that the leg is still short. In one unilateral case that Lorenz failed to replace, I immediately replaced, and the hip is still in. In two other cases operated on at his request, I was so unfortunate as to break the femoral necks. He broke the neck in one case and the shaft in another. One case that had relapsed from my operation, relapsed from Lorenz's operation; but in 1904, the father thought had been cured by another surgeon. There was a case that Christian Fenger tried and failed; I tried and failed; and Lorenz tried and failed. There was a boy eight

years old, with a left hip, $1\frac{3}{4}$ inches short: Lorenz thought it could be replaced. Another surgeon operated when the boy was eleven years old, but the leg is still short.

On October 15, 1905, a Chicago surgeon showed twelve cases before the Chicago Medical Society, all operated on by the Lorenz method. He said that they were all perfect replacements, and that he had knowledge of 32 cases operated on by Lorenz himself, of which 21 were anatomical replacements and 11 sub-spinous. I examined these cases sufficiently to satisfy myself that of the Lorenz cases the five unilateral hips were out, one bilateral case had both hips in, and the other bilateral case had one hip in. Of the five unilateral cases operated on by the surgeon who showed the cases, three were in and two were out. This is mentioned only to illustrate the fact that different surgeons report their cases differently (sic!).

From October 12, 1902, to March 4, 1904, I examined, but did not treat, 22 cases. I failed in six cases. Ten unilateral cases are in; 12 are out. Both hips are in in five bilateral cases, and in three both hips are out. In two cases one hip is in. Of 44 hips replaced, 23 are in and 21 are out. These figures may not agree with those in my paper in the *Journal A. M. A.*, April, 16-24, 1904—they are made from such records as I now have.

During the period between October 12, 1902, and some time in 1905, I operated by the Lorenz method, and during that time I had the mischance to fracture the neck of the femur five times, but I have been able to find the records of only three of these cases. Lorenz broke the neck of the femur twice and the shaft once while I was present. I saw him tear the perineum through from the vagina to the rectum in one case, and paralysis resulted in several. I first abandoned the stretching, and then the use of the wedge-block. The first real advance came with the realization that by fully flexing the thigh and thus throwing the head low, one avoided the greater part of the tension of the adductor muscles and possibly of the Y-ligament as a hindrance and could utilize them as a help to replace the head. Trying to lift the upper end of the femur forwards with my fingers at the back and my thumb in front, I learned to recognize the relation of the head to the socket and could feel the head leave my fingers at the back and rise under my thumb in front just before it slipped into the socket. This was a real advance. Since using this method, now about 17 years, I have broken the neck of the femur only once, and that in a case that had been manipulated by another surgeon for half an hour. I have broken the shaft once—the Hibbs case.

What do I mean by properly selected cases? All cases under two years of age and with shortening of less than one inch, and all cases over five years of age with shortening of over two inches, should be excluded. I have operated on cases of 17, 18, and 19 months, and many about two years of age, with shortening of only $\frac{3}{4}$ inch, and had many relapses as a result. I have operated on a bilateral case as old as 16 years and unilateral cases as old as 13 years, and on many with shortening of more than two inches—one $3\frac{1}{4}$ inches—and had accidents and failures and stiff hips as a result. Cases such as these diminish my percentage of perfect results; but I have made no attempt to separate my properly selected cases from the improper ones. I gladly leave that to the Committee. The result of a somewhat more careful selection of cases will appear in the greater percentage of perfect results which is shown by a comparison of my later with my earlier periods, for I have divided the time since March 4, 1904, into approximately five-year Periods. A large number of my cases have been cared for by other men; and this always lessens the percentage of perfect results. I operate on a case and it goes home after from three to six days, and I do not see it again until it returns for the removal of the cast. If the hip is securely in place I may never see the child again. If the hip is insecure, I request it to return at the end of six months. If it is then in, I count the case as cured unless I hear from it again. If the hip is out I send the case home to wait until the shortening is a full inch; then to return for replacement. Sometimes they return, and sometimes they do not. If they do not return, they may be satisfied with the result as perfect, or as an improvement from anterior transposition; or they may go to some other orthopedic surgeon. Dr. Francisco and Dr. Wallace each replaced one of my relapsed hips, and got perfect results. Dr. Henderson refused one of my cases, believing it not possible to get a perfect result. Dr. Steindler told one of my cases that the socket was too shallow to hold the hip. I might have differed from Drs. Henderson and Steindler, but I surely appreciate their courtesy to me.

A case is only perfectly followed up when a relapsed dislocation is replaced again and again, and possibly a third time after the shortening has reached an inch or thereabouts. I have not made any earnest attempt to get my cases back and replace them again and again as I ought to have done.

I have found it no easy matter to tabulate 437 cases. I attempted to tabulate ages and amounts of shortening, but gave it up as not of sufficient interest to be worth the trouble. I have not separated an-

terior, superior, and posterior dislocations to determine how many more in one class are perfect than in the others. I have tabulated the number of males and females—57 males and 380 females; the number of unilateral and of bilateral cases. There were 313 unilateral—116 right, 168 left, and 29 not recorded—and 122 bilateral. I have stated whether they were operated on or examined and not operated on by me; of the cases operated on, whether the hips are in, or out, or the result not known; and of bilateral cases, whether both hips are in, or both out, or one in and one out; and which is in and which is out. It is interesting to note that there are more unilateral left hips; and also that in the bilateral cases where one hip remained in and the other slipped out after the first operation the left hip slipped out twice as frequently as the right.

Here follow my results:

From March 4, 1904, to December 31, 1909, I saw 120 cases—13 males and 107 females. There were 91 unilateral—29 right, 52 left, 10 not recorded—and 29 bilateral. Thirty-six were examined and not treated. Of these, one unilateral case spontaneously recovered while awaiting operation (I have had a second case but have no record of it); one unilateral case is reported cured by another surgeon, and one bilateral case had one hip replaced by Whitman by manipulation and the other by the open method. She still limps. In one case I failed to replace. In 12 cases the result is not known. Of the unilateral cases, 32 are in and 22 out; of the bilateral cases, seven have both hips in, five both hips out, and six have one hip in and the other out—52 hips in and 38 out.

From January 1, 1910, to December 31, 1914, I saw 69 cases—9 males and 60 females. There were 52 unilateral cases—21 right, 26 left, and five not recorded—and 17 bilateral. Twenty-six were examined and not treated. One case I failed to replace. In four, the result is not known. Of the unilateral cases, 20 are in and seven are out; of the bilateral cases, four have both hips in, one both out, and six have one in and one out—34 hips in and 15 out.

From January 1, 1915, to December 31, 1919, I saw 63 cases—nine males and 54 females. There were 38 unilateral cases—16 right, 19 left, and three not recorded—and 25 bilateral cases. Ten were examined and not treated. In two cases I failed to replace. In seven the result is not known. Of the unilateral cases, 22 stayed in and seven slipped out; of the bilateral cases, 11 had both hips remain in, and in three both slipped out; in one case, one hip remained in and the other out—45 hips in and 14 out.

Since January 1, 1920, I have delayed operating on four cases until they are older. I have replaced ten. Nine are in and one is out and waiting for more shortening before being replaced.

The Hoffa operation: The one case done by McArthur and me resulted in failure. One case of Bradford's that I examined was a failure. In none of Whitman's open cases that I examined in 1900 was there any useful motion. The two cases operated on in Chicago by Hoffa himself relapsed within six months after the removal of the plaster casts.

The Sherman operation, aimed to slit the narrowed capsule and open the capsular pocket of the socket is, in my opinion, unnecessary if the child is made to walk on the replaced and retained hip for at least six months. Further, I believe it weakens the soft parts supporting the replaced hip. In the bilateral case that I replaced for Sherman, he cut down on the right hip just to see what I had done. When he removed the cast at the end of two months, this hip slipped out, the other did not. Both were finally retained after the child had walked on them for several months, and they were still in at the end of five years.

Osteotomy of the shaft before (Hibbs), or after (Sherman), replacement of the head in the socket appears to me to be absurd; because the operation is based on the assumption that the neck is twisted, carrying the head to the front, and that it needs to be turned back into the socket. The facts are that there are more posterior than anterior dislocations (and the posterior ones ought to turn the head backwards), but most dislocations are directly upwards, and there is no reason for assuming that there is a twist of the neck either to the front or the back.

In going over the histories of my cases, many interesting things are found that cannot be made to appear in a tabulated report.

In 1909 I operated on a boy $3\frac{1}{2}$ years old,—bilateral dislocation. A surgeon at Portland, Ore., removed the cast at the end of eight months; found one hip in and the other out; replaced the relapsed hip without protecting the other hip in the cast. The final result is both hips out. Compare this with a girl operated on by Henderson and Meyerding. Their result was one hip in and the other out. Somewhat later, when the shortening amounted to nearly an inch, I replaced the relapsed hip, protecting the good hip with a cast to the knee. Both hips are now in.

In 1900 I operated on a girl four years old,—bilateral. The result was the left hip in and the right relapsed. In 1902 Lorenz said that

the left hip was perfect. He replaced the right hip, but did not protect the left. The Lorenz hip slipped out, and he again replaced it in 1903. The result as shown by x-ray pictures taken about two years later, showed my hip turned forwards (*i.e.*, the head) and displaced upwards, while the Lorenz hip showed no evidence of a head, but it had a spur of neck pointing towards the socket. She walks with a "dip down" on the Lorenz side. What happened? Perhaps the following case will explain it: When Mr. Bartlett was in Chicago with his machine, a young woman, 26 years old, a patient of Dr. John L. Porter, with a dislocated hip, insisted upon an attempt to replace it. Whether the dislocation was congenital or spontaneous, we could not guess from her story, but Dr. B. E. McKenzie of Toronto had treated her with a long traction hip splint. At the operation, Bartlett worked the traction mechanism and Porter the lever to pry the head into the socket. When they were unable to replace the hip and the region back of the femoral neck had been badly bruised, Porter asked me to try to replace it by manipulation. With the exercise of little force, the neck of the femur broke. During the following six or eight weeks the broken-off head was so completely absorbed that it did not show in the x-ray plate. Before the operation, it had appeared normally dense.

The recognition of defective hips that are not dislocated is important. In 1902, Lorenz replaced the left hip, two inches short, in a girl of ten years. When I removed the cast eight months later, the hip operated on was in anterior transposition, while the other hip was dislocated upwards and backwards. In 1903, Steele (D. A. K.) and Porter replaced the right hip of a girl after having an x-ray picture which showed the left hip in the socket. When the cast was removed, the hip operated on was in place and the other hip was out. I examined the case in May, 1904.

Operations on very young children should not be done; practically all of mine have relapsed. Compare the following two cases: In 1904 I operated on a girl 19 months old. Six years later, there was a shortening of an inch. In 1912, I was requested to operate on a girl 16 months old. I refused to operate until she was older. After a delay of two years I replaced the hip. Now, seven years later, the mother writes, "The hip is perfectly all right." Another reason for not operating on very young children is that I have had two babies brought to me with dislocated hips, in which the femoral heads could be felt under the buttock muscles when the thighs were flexed and adducted, and they appeared less well in the sockets than the opposite hips by the x-ray

pictures, but when the children were brought for operation at the proper age the hips were found not dislocated.

In 1904 I attempted to replace a hip only one-half inch short, in a girl of 17 months. I did not know why I failed until some years later, when operating at the Home for Destitute Crippled Children, before the members of this Association, on a very young child with little shortening, I thought I was going to fail, but on reducing the amount of flexion of the thigh, thus raising the head in relation to the socket from a too low position, it readily entered.

By the same token it is not well to attempt to replace hips in very old cases. In 1914, I examined a girl 17 years old, whose hip another surgeon had attempted to replace six months before. The hip was still out and the leg paralyzed. The result of Lorenz's work in Chicago left some cases of paralysis, but in so far as I know, all recovered. One of these cases was recently examined for me by Dr. Eikenbary. Lorenz failed to replace the hip; told the father that he had really put the hip in; collected $500; when the cast was removed again, told the father that the hip was in. The same day I examined the child and had an x-ray plate made. The hip was out. The girl recovered from her paralysis and is now very well satisfied with the result.

In 1914 I operated on the right hip of a girl $9\,{}^{7}/_{12}$ years old, at the request of Dr. Loman. The shortening was $3\frac{1}{4}$ inches. The replacement was very difficult. The child suffered very much for ten days. After the cast was removed, at the end of eight months, the hip slipped out. Two months later I replaced it. A year later it was out again, and the x-ray showed a small and flattened head.

In 1902 Lorenz refused to operated on a girl of nine years with the the left hip dislocated, but advised me to do so. I did,—and broke the neck of the femur. The leg was put up in a cast in moderate abduction. A year later there was still some abduction, and quite a stiff hip, but she walked very well.

Lorenz failed to replace the hip of a girl seven years old, which I immediately replaced. On removal of the cast, at the end of eight months, the hip was in and the femur of normal shape, as shown by the x-ray picture. Twelve years later, she came in to show me her perfect hip. I found a leg $\frac{3}{4}$ inch short, and the x-ray showed that the head had been displaced downwards—coxa vara—to the extent of the shortening. In those cases that have replied to my letters of inquiry saying, "The girl walks well, with scarcely a limp, but has $\frac{1}{2}$ to $\frac{3}{4}$ inch shortening," I wonder whether such hips have coxa vara, or are out. I have tabulated them as out.

How should a case be tabulated that was operated on by Lorenz when nine years old, right hip, two inches short, which on removal of the cast I found to be one inch short, but the mother now says is a perfect hip? I have tabulated it as out.

Lorenz failed on a girl nine years old, left hip, $1\frac{3}{4}$ inch short, after both Christian Fenger and I had failed. But after 19 years, I examined the woman and found her walking with scarcely a limp—wearing an extended shoe.

In 1903 I operated on the left hip of a girl 18 months old for Dr. Gillette. In 1914 he wrote: "I find $1\frac{3}{4}$ inch shortening. Greater trochanter above Nélaton's line. Motion free in every direction. Resembles a coxa vara." I wonder what the condition really is; but I have tabulated the case as out. In the same way, I have tabulated the result in the right hip of a girl of seven years. Hip replaced in 1917. On removal of the cast, Dr. C. A. Parker thought the head anterior. The father now writes: "Some shortage exists. Amount not known. Big girl. No discomfort or fatigue."

It is a good rule to never attempt to replace a hip that another has tried and failed to replace. In 1908, Dr. J. B. Murphy asked me to operate on a girl, bilateral, seven years old, with $2\frac{1}{4}$ inches shortening. The right hip was no more difficult than would be expected in a girl of seven years with a $2\frac{1}{4}$ inches shortening. When I attempted the left hip, I found the feel quite different, and on turning the child over, found a bruise from the wedge-block back of the neck of the femur. Nevertheless I was seriously assured that no attempt had been made to replace the hip. The result was that the right hip is in and the left anterior.

Some five years ago I was assisting Dr. C. A. Parker. After a prolonged and futile effort he asked me to try. The femoral neck broke in my hands with less than half of the usual force used to replace a hip. Did I break it, or did we both break it? This is the only fracture of the neck that I have had since I abandoned the Lorenz method. I have broken the shaft of the femur once (Hibb's case—a girl with bilateral dislocation, seven years old, $2\frac{1}{2}$ inches shortening, that never should have been attempted). By the Lorenz method I broke the neck of the femur five times, but I find only three among my tabulated cases. In 1902, I saw Lorenz break the neck twice and the shaft once. The difficulties presented by some cases may be illustrated by the case of Dr. M. L. Harris, reported by me in 1905 (*Chicago Medical Recorder*, September, 1905). A girl, five years old, bilateral. Harris, assisted by Ryerson and Hosmer, attempted to replace by the Lorenz method,

and failed. Three days later, the same three surgeons, with Mr. Bartlett and his machine, tried, and failed. Nine weeks later, Harris replaced the left hip by the open method. Four months later the cast was removed and the head of the femur found dislocated on the dorsum of the ilium. Harris, assisted by Ryerson, attempted a "bloodless" reduction, and broke the femur in the neighborhood of the trochanters.

In 1905, I examined a girl from Boston who had had a bilateral dislocation. Bradford had replaced one hip by manipulation. When it relapsed he did the open operation. That also relapsed, and the hip was still out. The other hip was replaced by the Bartlett machine, and remained in.

In 1907, I examined a girl 7½ years old with 1¼ inch shortening. The mother stated that when the child was 14 months old, Dr. A. H. Ferguson operated. Without attempting to replace the head in the socket, he had turned down a flange from the outer table of the ilium over the head. The x-ray picture showed it apparently as after the operation. The mother said that the shortening had not increased.

Other congenital malformations sometimes add to the interest of these cases. My first one was a girl four years old whom Lorenz refused to treat. In addition to both hips dislocated forwards, she had recurvated and stiff knees, talipes equinovarus, clubbed hands, somewhat flexed and stiff elbows, and webbed axillae and little movement at the shoulders. The hips were replaced, the knees and feet cured, and the hands greatly improved. The next case was a girl of three years. She had the same deformities of the lower extremities. The third case, a boy, 2½ years old, had dislocated hips, straight, stiff knees with absent patellae, equinovarus, clubbed hands, shoulders somewhat stiff, prepuce adherent, and meatus urinarius opening back of the glans penis. I did not treat him. Another case, of which I have no record, had the left hip dislocated, recurvated left knee, and equinovarus of the left foot. All were cured. Another, a girl four years old, had the left hip dislocated, the limb ¾ inch short and bilateral genu recurvatum. A girl, born with spinal kyphosis and talipes calcaneus, had a hip spontaneously dislocate when 3½ years old. Another girl, in addition to dislocated hips, had spina bifida (lumbar), recurvated knees, equinovarus, paralysis of motion and sensation in the feet, incontinence of bladder and bowel, and hydrocephalus. Otherwise she was normal. These cases of multiple deformities have usually walked very little or not at all, and the replacement of the dislocated hips, which are usually forwards, is very easy

All such hips that I have replaced and caused to be used in walking for at least eight months have remained in. I have had one congenital dislocation in a child with spastic paralysis. I tenotomized the adductors before replacing the hip.

As to preliminary stretching before replacing difficult hips: My last case was in 1903, a girl nine years old, bilateral, three inches short. After six weeks weight-and-pulley traction, the hips were easily replaced. But it was found that this cut off the pulsation in the posterior tibial arteries. The cast was removed and the hips re-dislocated. Two cases not included in my 437 were not dislocations at all. Both were publicly operated upon by Lorenz as congenital dislocations and so reported in the newspapers. One was a girl of eleven years, operated on in San Francisco. The father brought to me, two years later copies of the papers in which the full details of the operation were published, even to a fake x-ray picture. The case had been treated some years earlier by Dr. H. M. Sherman for hip tuberculosis. She never had a dislocation. The other was a girl of three years that I had treated for a year for active tuberculosis of the hip. Lorenz manipulated the hip, which had no deformity, at Mercy Hospital before a large audience, as a case of congenital dislocation, and the daily papers so reported it; but he put on a cast, not with the thigh in right-angled abduction, but straight down, and privately asked me to remove the cast at the end of a month and continue the treatment.

The tabulation of some cases has been difficult. One case that I examined in 1906 was operated on by another some months later. The hip is now out and the leg short. I have tabulated it as a hip that is out, not as one examined and not treated. In 1914, I replaced the left hip in a child of three years. The hip was in on removal of the cast. Now, 1921, the mother writes: "She gets around fine, but the hip is not filled out well, and there is shortness." How should it be classified? I have counted it as out.

On several of my relapsed early cases Lorenz operated; all were failures or relapsed, and I have counted them only once, as my failures and relapses. For the main thing that we wish to know is: What per cent. stay in—not who put them in, or who failed to keep them in.

Finally, let me say that some of the 1915-19 cases that are now out will be put in again. Some will stay in.

I have missed a number of operations by refusing to operate on very young children with shortening of only ½ to ¾ inch. I have attempted several cases that were too old or that had too much shortening, with the result of some fractures and some stiff hips. Some of the

cases rejected twenty years ago write me that their hips trouble them very little. Some of the cases where Lorenz tore the adductors and, failing to replace, put the leg in plaster in abduction for several months, believe that they are greatly improved. Lorenz spoke of "perfect" results and "good" results. The good results were those cases in which the head passed forward from the socket and then went up to 1 to 1½ inch and became anchored near the anterior superior spine of the ilium. The lordosis of the spine and flexion of the thigh were wiped out, and the patient stood straight and walked well. These are certainly good results when one cannot get perfection.

In none of my cases is there any evidence that a hip that remained in for a year after the removal of the cast has ever relapsed unless subjected to traumatism sufficient to dislocate a hip with a large and shallow socket.

In none of my cases is there any evidence of a narrowed or contracted socket. In every relapsed hip that has been radiographed in adult life, the socket has been shown to be large and shallow. Radiograms of the sockets of young children do not show the real shape of the sockets. Doubtless there are sockets too shallow to retain the relapsed heads, but most of the ultimate failures should be credited to operating too early, to lack of use during the period of retention, and neglect to replace the hip a second or third time after allowing sufficient time for shortening to take place.

From my records it is not possible to answer all of the details asked for by your Committee:

1. The age is generally on my records.

2. Also, which hip, or both. Those having other congenital defects are recorded. None had rickets.

3. X-ray pictures, both before and after the operation, are available in comparatively few of the cases.

4. My cases are classified as to the method of reduction. Since 1900, all cases have been put in plaster casts in right-angled abduction with 90 degrees outward rotation, except such as felt more secure without rotation, and these latter which require the plaster below the flexed knee have been released to the knee at the end of two months to enable the children to walk. This allows the thigh to rotate out to about a mid-position. All cases have been held in plaster casts in right-angled abduction for eight months or more.

5. The plaster cast—a heavy one—has been put on over stockinette covered with half an inch of sheet wadding bandages firmly and smoothly bound down by a roller bandage. In unilateral cases, only

one leg has been included. In a single relapsed hip in bilateral cases both hips have been put in the cast. All cases walk as soon as possible; unilateral cases within two weeks, and bilateral cases within two months. After the removal of the cast the parents flex, adduct and rotate inward the thighs.

6. I class my cases as "in" when they are in, and as "out" when they are out; but hips that are out may be "good" hips. They should be so classified if they have good abduction and no more than 1½ inch shortening when fully grown. Many with two inches shortening think that they have good hips. All others are failures or relapses. Some failures have useful limbs if given full abduction. Some perfect replacements have a "poor" result because of stiffness due to too extensive shortening of the muscles at the time of operation.

7. None of my cases have been goniometered.

DISCUSSION ON PAPER OF DR. RIDLON AND REPORT OF THE CONGENITAL HIP COMMISSION.

DR. OSGOOD: The discussion on the paper of Dr. Ridlon and the Report of the Commission will be opened by Dr. E. H. Bradford of Boston.

DR. E. H. BRADFORD, Boston: *Mr. President:* I think that the Committee are to be congratulated, not only on the boldness of their undertaking, but also on the thoroughness of the attempt. I feel that they have shown to us how difficult the task is.

It is undesirable to take up the time of the Association with any remarks, especially as I am to be accorded, on Monday, the privilege of presenting this subject later. It is most gratifying that this subject be brought up and thoroughly discussed. When first presented to the American Orthopedic Association, many years ago, it was looked upon as a discussion of an impossibility. The treatment of congenital dislocation of the hip was formerly considered almost useless. The only question at present is as to the best method of operation and in how few cases failure may be expected.

Dr. Bradford stated formerly that he was of the opinion that the reduction by open incision was the most reliable method of treatment in these cases and he has performed over fifty cases by open incision, with a fair percentage of satisfactory results, but later experience has convinced him that the manipulative method, properly performed, with careful after-treatment, gives the best results. He stated that he is confirmed in this opinion by an examination of several cases, ten, fifteen and twenty years after reduction, some by open incision and others by manipulative method. Functional results in the latter were superior to the results obtained by reduction by open incision. The results now obtained give evidence that the deformity, properly treated, is an eminently curable one.

DR. HENRY LING TAYLOR, New York City: *Mr. Chairman and Gentlemen:* I have a few words to say. This demonstration is of extraordinary interest

and value. The members of the Commission have shown that this is a very complex subject—much more so than we realized before—and that this renders the classification of the cases and of the results exceedingly difficult. We shall await the final report with a great deal of interest. I have just jotted down a few notes in which you may be interested. I indicated in a paper, two or three years ago, that the conditions in babies were very different from those in older children, much more favorable, and they should be operated on at once. My suggestion was that babies had a much deeper acetabulum; that, when the deformity was reduced, the reduction took care of itself, and that these cases could easily be reduced without giving an anesthetic. I, myself, have tried this, at the Hospital for Ruptured and Crippled, in the last two years, and I have found it to be true that cases in infants can be reduced without an anesthetic and without too much pain. However, we have not found the acetabulum much better than in the later cases, or that the cases in infants retained themselves. They had to be put up in plaster, and the cases followed the course of older cases. In the case of an older child with a displacement of only three-fourths of an inch, even after anesthesia, we found it very difficult to reduce it by that technique. We gave up the Lorenz technique, bit by bit, from the start, making it milder and less violent, until there was nothing left of it. Then, when we became more familiar with the French technique, we adopted it, with good results. I learned that from Dr. Ducroquet, who visited this country some years ago. It consists in reducing the hip and stretching it afterwards—in about seventy per cent. of abduction, with inward rotation from the start, if practicable and if the reduction holds, and increasing inward rotation as the abduction and flexion are reduced. My results since adopting this technique have been extraordinarily better.

I believe, also, as has been suggested, that the after-treatment is important, and a feature of the after-treatment that I emphasize is the reduction of the inward rotation, which I do by adhesive plaster strapping. The child is encouraged to pronate for some time after all the plaster is removed. This is a great advantage.

I appreciate the anatomical points brought out, and, as Dr. Bradford stated, the fact that the x-ray, unless it is good and you know how to read it, is a fallacious guide.

Another thing that I want to mention is the formation of new bone in the hip. I have observed that new bone was formed in the acetabulum by deposit at the superior edge of the acetabulum.

Dr. Albert H. Freiberg, Cincinnati: I shall not detain you more than a moment. As one of the earlier advocates of these commissions, I wish to express my approval of what the Committee has done and to say that I am convinced by what it has done that this is a good way to investigate subjects of interest to us. I feel, however, that a suggestion to the Committee would not be inopportune.

I think that, perhaps, the members of this Committee are making the scope of their investigation too broad. This makes the investigation more difficult. In making a report, no one speaks of his failures, but only of those cases that he believes were successful, which have stood the test of three years. I, too, have had failures—plenty of them. I believe that in the future work of the Committee, the scope of the investigation should be limited. In that way, we shall have results more valuable and easier to use. The question of the abnormality of the supposedly normal hips is interesting because, twenty-two years ago, I reported that in forty per cent. of the cases there was some abnormality found in the supposedly normal hip.

Dr. Walter G. Stern, Cleveland, O.: I was very much surprised to learn from the report of Dr. Adams, that no one but myself had used the Worndorf-Schlesinger position. When I visited the Lorenz Clinic in 1899 and 1900, I was impressed with the terrific force used to reduce the hips, and in the work that I was allowed to do there, I did not use the brutal method that

they employed. I succeeded in getting the hips back. When the Commission came, they did not use the force that Lorenz used. There are some other positions besides the Frog-Schlesinger-Worndorf. The Schlesinger was used where one had not succeeded in reducing the hip, to put it up in plaster; and in a few weeks it was possible to succeed, in some cases, at the second sitting, in reducing the hip. Worndorf suggested that in cases in which you got the hip in place but in which it immediately dislocated when the hand was taken off the knee, you put it up in such an exaggerated position that the knee come under the chin and then leave the cast on for many months.

My 199 cases were not typical Lorenz operations. They were done by a manipulative method. It is a hark back to older methods. I do not claim credit for it myself. Last June, I had my assistant collect all the cases over three years old and report on them. His report is found in my report.

Dr. John Ridlon, Chicago: Many years ago I read a paper on "Spontaneous Dislocation of the Hip," and called attention to the fact that the condition might be called that, instead of "congenital dislocation." I brought out the fact that many defective hips are not congenital. I showed a picture of an elderly man who had never had trouble, and only three-fourths of the head of the femur was included in the acetabulum. The question of continuous pressure from growth as mentioned by Dr. Adams, I have not tried. Of course, it is a choice whether you will try to get the head to go in by that method, and not lose all the benefit of walking, or whether you will use the benefit of walking and discard that method. I believe that the benefit from walking in the plaster cast, after one month in unilateral, and after two months in bilateral cases, is more and more to be recommended. A large percentage of these cases we have no final reports on. Those in which we know whether it was in or out, we only know whether it was in when last seen. Some that were in then may have come out since. The Committee should remember that the proportion of these would be the same as in those which we do now.

As to the standard neck, shown in the pictures, and dwelt on so strongly by the Committee, I think that it is all nonsense. If you notice, the neck is as big as the shaft. The neck, normally, is not so big as the shaft. It has been discussed in what position the hip should be placed in order to best retain it. I think that the best position is the one that is found by the manipulator to be the most secure, when he has replaced the hip. That is all there is to it.

Dr. Joel E. Goldthwait, Boston: I have nothing to say in conclusion, except that the Committee will welcome criticism or suggestions from you, and will work accordingly, as far as we are able. We are your servants. Let us know what you want us to do, and we will go at it.

We felt that the broad attack was necessary first, and then we could draw our conclusions in regard to special things afterwards. We supposed that you wanted the entire subject covered. We, as a scientific body, ought to be able to speak of every phase of it with reasonable intelligence.

MANIPULATION OF STIFF JOINTS.

BY SIR ROBERT JONES, LIVERPOOL, ENGLAND.

ONE of the difficult problems presented to a surgeon is the decision as to when a stiff joint is to be moved and when it is to be rested. In other words, the diagnosis between a joint rendered stiff from active, even if very mild, arthritis, and a joint hampered in its movements by adhesions or adaptive muscle shortening.

An arthritic joint is dependent upon rest as a preliminary to motion. A joint restricted in its movements by extra-articular adhesions has to be approached with the view of movement active and passive. If adhesions do not yield readily to active and gentle passive efforts, the question of more forcible methods has to be considered. Attempts at moving arthritic joints lead to greater stiffness in consequence of inflammatory reaction. It is necessary, therefore, to emphasize certain principles to assist us in making a differential diagnosis.

A painful joint which is rigid in all directions is the seat of an arthritis, while a painful joint which is rigid in certain directions only—movements being normal in others—is free from arthritis. This is more obvious in joints such as the wrist, shoulder, hip and spine, which have a comprehensive range of movement, than in joints such as the elbow, ankle and knee, where the movements are practically limited to flexion and extension.

If there be no limitation of movement in a suspected joint, there is no arthritis. In early cases the rigidity must be examined for without an anaesthetic, as it is primarily due to protective muscular fixation. Later, contractures or muscle shortening will follow as secondary effects, but by then a diagnosis will be obvious. One illustration will suffice to make this clear. A girl complains of pain in the dorsolumbar region of her spine. The surgeon asks her to flex, extend, rotate and laterally move her spine. If she can do so she has neither adhesions nor arthritis. Another may have great tenderness over her spine, and is unable to fully flex or laterally deviate her spine, but she can hyperextend. This case can be assumed free from arthritis and may probably have adhesions. A third case is rigid in every direction, and her condition may be diagnosed as an arthritis.

This classification requires modification when we deal with fractures into joints with bony blocks, or with myositis ossificans in the muscles surrounding a joint.

Adhesions may be divided into two groups—(a) intra-articular; (b) extra-articular.

Intra-articular adhesions may be the result of rupture of joint capsule, of hemorrhage, or of the plication, with adhesion, of the synovial membrane. Rupture of the intra-articular ligaments, such as the crucial and ligamentum teres, do not give rise to adhesions which require surgical attention.

Extra-articular adhesions may be connected with the capsule, the ligaments, muscular origins or insertions, rupture of the muscular fibres or blood extravasation into tendon sheaths. Stiffness of the joint may also be the result of adaptive muscular shortening, physiological in character, or it may be due to loss of resilience in the sheaths surrounding muscle and muscle fibre.

Prolonged immobility of a healthy joint will result in temporary stiffness, which is usually due to adaptive shortening of soft structures, and this can be rectified without forcible manipulation.

The stiffness of the knee following a simple fracture of the shaft of the femur is usually overcome in three or four weeks if the fracture is not in the neighborhood of the joint. If the fracture has been compound and septic the stiffening is often most intractable and may give the surgeon much anxiety, but our war experience has taught us various methods by which joints may be kept mobile while the fracture heals.

THE PREVENTION OF ADHESIONS

Adhesions are avoided by early and safe resort to active and passive movements. These movements should be practically painless, and should consist mainly in assisting the patient to move his own joint. If there has been no direct injury to the joint the proposition is a simple one, but care is needed that the movements practised on the joint are not conducted to the fractured shaft, while means should be adopted which will permit uninterrupted extension. It is here that the training and ingenuity of the orthopaedic surgeon counts.

In direct injuries to joints unaccompanied by fracture, movement may be given immediately on the cessation of acute symptoms. The joint should be immobilised until the acute symptoms have passed. The clinical test of the cessation of acute symptoms is the disappearance of swelling and tension pain. When local effusion and tenderness abate, the patient may be allowed to commence gentle active movements. He will surely be careful to move the joint gently enough to avoid pain and danger. *In the case of children*, gentle passive movements may be started before active movements, and they should be

so conducted that the joint is ultimately moved in each direction that its anatomy permits. The full range of movement should not be attempted at once, nor should there be practised more than one movement in each direction. It should be designed to gently free the way for movements in order to prevent the formation of adhesions. It is necessary that the child's confidence and good will should be assured. You cannot give of your best to a child who fears you. A surgeon who deals with a child should gain its trust and love.

ON BREAKING DOWN OF ADHESIONS

Light adhesions may be broken down under gas, or gas and oxygen; if strong and resistant, full anaesthesia is best. Complete muscular relaxation is rarely obtained under gas, and, in consequence, the surgeon is less able to gauge the force he should apply. The joints should be moved through the full anatomical range unless the adhesions are extremely firm. If firm and resisting, the movements should be less complete, and full mobility should be secured in stages. The advantage of the use of gas is that the movements may be voluntarily practised almost at once, and this is of considerable psychological advantage. After all adhesions have been overcome, and while the patient is asleep, the limb should be placed in the position of full correction until he recovers consciousness and is able to make a voluntary effort. This helps to emphasize the right of way, and furthermore, has a good mental effect, for the patient, when he becomes conscious, realises that the obstruction has been overcome. The earlier movements are practised after manipulation the better, for the pain is less acute and the results more rapid and effective. If, however, the manipulation has been very severe and reaction is feared, it is advisable to fix the limb for a few days in the corrected position in order to rest the assaulted joint, massage being substituted for movement.

The normal range of movements in a joint varies in different people and at various ages. It is advisable, therefore, during our manipulation of any joint, to compare its range of movement with that of the opposite side. Unless this is done, it is easy to produce a sprain.

If, as a result of manipulation, the range of movement is diminished, it is fair to conclude that the after-treatment has been defective, or that the manipulation has been ill-advised. After the joint has been conducted through its complete range of movement once, it is useless and often harmful to repeat the procedure. The "pump handle" method, as applied to the breaking of adhesions, or the practice of

passive movements, is to be avoided. Voluntary efforts, however, can be repeated with advantage as often as the patient can be persuaded to make them.

Passive movements and the breaking of adhesions by manipulation in the presence of fracture near a joint, should be most carefully performed. The fracture should be adequately protected from strain by closely applied splints.

If effusion should take place in a joint after manipulation, it is strongly suggestive of the rupture of intra-articular adhesions. Such effusion does not necessarily imply that the manipulation should not have been employed *unless* the effusion is accompanied or followed by a diminished range of movement. If the range of movement is diminished by use and exercise, the joint requires rest. If, even in the presence of pain, the range of movement is increased by exercise, rest is contra-indicated.

The rupture of typical adhesions is heard and may be felt under the hand. If no click is heard or felt, but the resistance is overcome by a gradual stretching, the prognosis is not so good, and the joint should be retained at rest for a few days in its new and corrected position. Passive movements should then be gently practised. Pain which is sharp and of short duration is negligible, but if pain continues for protracted periods, it means a reaction likely to be followed by increased stiffness, and calls for rest.

FORCIBLE MANIPULATION AS APPLIED TO INDIVIDUAL JOINTS.

Shoulder.

The dangers to avert in forcible manipulation of the shoulder are fracture and dislocation. Normally the humerus can be abducted almost to a right angle from the body without scapular aid. It can be rotated a little more than a third of a circle. The internal condyle on complete external rotation of the arm, points a little to the front of the side. The arms can be abducted by scapular aid in a young adult so that they lie parallel above the head.

The patient should lie on his back while an assistant places his fist in the axilla to protect the head of the humerus from displacement or fracture. The surgeon should then grasp the arm above the elbow with one hand and abduct it; with the other, he should control the shoulder girdle to fix the scapula. When the right angle is reached, the scapula is left free, and the arms should be abducted to the normal range of movement. A comparison with the movements of the second arm will check the surgeon from over action. When the arm is fully

abducted, the patient's hand should be placed behind his head, and the joint should be pressed backwards until the arm assumes the position it occupies during a yawn. The shoulder should then be rotated inwards and the forearm placed behind the back. The forearm should then be brought to the front and fully extended and supinated to free any adhesions which may have formed about the biceps tendon. The shoulder is then circumducted, the palm of the hand being finally placed behind the occiput. The patient should awaken from his anaesthesia in this position. The rotations must be very carefully performed in order to avoid fracture, and abduction is also a movement which may produce fracture in the aged. In addition to stiffness following sprains of the shoulder or adhesions in connection with bursae. we may have to break down adhesions in fracture of the anatomical or surgical neck of the humerus, in reduced dislocation of the shoulder, in fracture of the outer end of the clavicle, and in separation of the tuberosities; and on recovery from the subacute arthritis which follows a fall on the shoulder or a fall on the palm of the outstretched hand.

In fracture of the neck of the humerus, great care should be taken to avoid refracture. and forcible movements should never be attempted in less than two months after injury. I have known the arm to be refractured on many occasions. In fracture of the greater tuberosity, special attention should be concentrated on the rotary movements.

The condition which I have called subacute arthritis of the shoulder requires a short description. It is usually due to a stubbing of the joint, and is often associated with a Colles' fracture. Old people with a Colles' fracture often complain of pain in the shoulder about three or four weeks after their accident. The symptoms are rigidity in all directions; pain on pressure over the front of the joint just to the outside of the coracoid, and inability to lie upon the shoulder. The signs of recovery are a shifting of pain from the front of the joint to the insertion of the deltoid and ease when lying upon the shoulder.

Elbow.

The management of the elbow joint requires more care and judgment than the shoulder. If the adhesions are light and there is no injury to the joint, all that is needed is to completely flex and extend with the forearm first in complete pronation, then again in complete supination. In this way adhesions of the radio-ulnar articulation are simultaneously overcome. If adhesions are firm and limitation of movement marked, as is often the case in the presence of an old frac-

ture, the elbow should be gently extended in supination and then flexed to safety point, and fixed in this flexed position by a sling for a few days. It should next be extended and fixed in extension for no longer than two days. When freed, active and gentle passive movements may be practised. While these passive movements are performed the fracture should be protected from strain by splints. The movements may require repeating in a few days.

The stiff elbow joint, especially in the case of children, often becomes mobile by use, even in those cases where passive movements are followed by reaction; and it frequently happens that when massage and passive movements have failed to make an impression, and have been discontinued, the child will appear a few months later with free motion in the joint.

When, in the course of passive movements, an elbow-joint becomes more stiff, and that painlessly, traumatic myositis ossificans should be remembered as a possible factor. This condition is generally associated with fracture or dislocation, and it will often be found that the coronoid process is torn away.

The manipulation of the elbow joint should always be gentle, and if the range of movement increases by use, even if very slowly, voluntary exercise should take the place of passive movements. If motion becomes restricted with exercise, rest is called for.

The Wrist.

This joint should be dorsiflexed, palmar flexed and moved laterally. These movements should be followed by circumduction. The fibro cartilage and carpus should be moved to and fro on the head of the ulna while the forearm is supinated. If these movements are restored without much force, active movements should be allowed immediately. If dorsiflexion has been difficult, the hand can be fixed in this position for a day or two. If palmar flexion is limited and cannot be corrected without considerable force, the hand should be fixed in the corrected position for twenty-four hours in order to avoid reaction, and then active movements can be practised.

Adhesions of the mid- and postcarpal joints are met with, chiefly in connection with Colles' fracture, or with fracture or dislocation of the carpal bones—most frequently the scaphoid and semilunar. Free movements must be secured quite soon when these fractures have occurred, as later massage and manipulation will not secure free mobility at the wrist. Immediate correction and temporary fixation, either in dorsiflexion or palmar flexion, is therefore imperative.

The disabilities following fracture with displacement of the scaphoid and semilunar are often very obstinate. If in the case of a recent injury to these bones after attempted reduction movement is free, a perfect result can be predicted. If, in spite of such attempt, movements are restricted, the bone should be removed, as no subsequent treatment will restore ball motion. If the scaphoid or semilunar is removed at once, a good result may be expected. If the removal be postponed, the function of the wrist will be imperfect. If an operation be refused, the dorsiflexed position of the wrist should be secured.

The movements between forearm and carpus are condyloid, and therefore all movements, excepting rotation, are possible. The movements of the mid-carpal joint are those of flexion and extension, with very slight rotation and a slight gliding movement. These should be remembered when manipulation is performed.

In manipulating the fingers, extension should always be employed while adducting and abducting. Rotation should be practised while the fingers are slightly bent. The movements should be gentle in order to prevent tearing of the ligaments. All manipulations of the fingers should be practised with the wrist dorsiflexed.

The Hip.

In addition to the stiffness of the hip joint as sequelae of so-called sprains, I would like to call attention to the marked pain and stiffness which are associated with hypertrophic osteoarthritis of the hip of the mon-articular type, and the relief which is so often derived from manipulation under an anaesthetic. If the osteophytic exerescences are not excessive, and the subject not too frail and old, I very frequently attack the adhesions so inseparable from the condition. The results are often very dramatic. The pain almost disappears, and the range of movement is very materially increased. The improvement lasts for two or three years, sometimes more. In such cases, the full range of motion is never attempted, attention being specially directed to external rotation and to abduction. Forced movements of an intensive type are begun the next day, and cases which I would have looked upon in former days as destined to lead the life of a chronic painful invalid may, by this expedient, have their outlook considerably brightened.

In manipulating the hip joint, the patient lies on his back with both limbs fully extended; they are then rotated inwards and outwards. The legs are next crossed in adduction, to be followed by flexion of the knees to right angles and the thighs abducted. Full

flexion at the hips should be followed by abduction, rotation and circumduction. These movements are best performed simultaneously on both sides so that the limits of normal movements may be noted. For complete extension, the patient lies on his back with the pelvis supported at the end of the table, and the limb is extended, while the good thigh is flexed on the abdomen. In circumducting the hip, the foot should be conducted through a series of circles of increasing circumference.

The Knee.

The knee very frequently calls for manipulation. It is a joint very apt to deceive a surgeon, owing to the apparent simplicity of its movements. In a ball and socket joint, the variety of movements which are displayed allows a wider scope for differential diagnosis. It is so often the seat of mild septic infections and effusions of a chronic type, accompanied by pain, which tend to make a surgeon over-cautious. In certain disabilities, it is found slightly flexed, which is also fairly constant in arthritis. In addition to this, a knee may present a glazed appearance accompanied by exquisite tenderness, both to touch and movement, so that any drastic interference with it seems hazardous. I will describe three types.

A middle-aged woman appears with a knee in full extension. She is unable to bend it beyond a few degrees, and any attempted movement gives rise to great pain referred to the front of the knee. There is no effusion: she walks comfortably in a splint, which she has worn at intervals for over twelve months. Careful inspection reveals a swelling about the lower part of the ligamentum patellae, with a slight oedema on pressure. Massage and attempted passive movements have, on each trial, had to be abandoned because of pain. She has many x-rays, which show no abnormality. The oedema and acute pain have been generally diagnosed as periostitis of the tibia. This proved to be a case of adhesions about the insertion of the ligamentum patellae brought about by prolonged kneeling. Rapid manipulation of the knee resulted in complete recovery in less than three days.

A young man met with an accident at football four months previously. The knee was displaced and was reduced, so he said, the same day. Effusion followed the strain, and for a fortnight he wore a splint. He was a joiner, and went to work, his knee feeling a little stiff, and mild effusions recurring. On examination, he had slight pain on pressure in front of the internal lateral ligament, and when any effort was made to hyperextend his knee, he complained of con-

siderable pain at that spot. When he tried to extend both knees and a comparison was made, it was noticed that his injured knee fell just short of complete extension. This condition, commonly met with, was recognized as an incompletely reduced semilunar cartilage. Manipulation and immediate exercise restored the function of the joint.

A youth twists his knee and sustains injury to the internal lateral ligament. Three months later all his movements are free, but he complains of pain on walking, especially if he traverses rough or undulating ground. For this reason he is unable to play games. There is slight pain on pressure over the ligament. If the knee is flexed to 90° and rotated, pain is at once referred to the same place. This was a case where adhesions had formed between the internal lateral ligament or capsule, and the internal meniscus or coronary ligaments. Manipulation rectified the condition at once. The point to note in regard to manipulation for this somewhat common condition, is that while the knee is flexed the head of the tibia should be rotated inwards and outwards on the femur. This is the particular movement that counts. The symptoms are frequently mistaken for recurring partial displacement of the semilunar, and provide a rich harvest for the irregular practitioner.

These three types are worth recording as they are so generally overlooked, even by observant surgeons.

Should the old displacement of the semilunar, with its symptom of very slight flexion at the knee, cause the surgeon to fear arthritis, he has only to remember that in arthritis the knee becomes more flexed with use, while in the case of the cartilage the angle tends, if it alters at all, to diminish as time passes. The arthritic knee is warmer than normal: the knee which requires manipulation is usually cooler.

Before manipulating a knee, the patella should always be examined. It is never safe to attempt to bend a knee with fixed patella; nor is it wise to attempt forcible manipulation in cases where the quadriceps is firmly adherent to the femur. Intra-articular adhesion following mild septic infections can be cautiously forced. It is safer, however, to adopt the more gradual methods which I have discussed elsewhere in dealing with such cases.

In breaking down adhesions, the joint should be fully flexed while the tibia is rotated upon the femur. This rotation should be continued while the limb is brought into full extension.

In displacement of the cartilage, the joint is first fully flexed and, while in this position, the leg is rotated inwards. If no anaesthetic is given, the patient is asked to kick his leg as if at a ball, while pressure is applied simultaneously downwards above the knee and upwards below the ankle

If full easy extension is not at once secured, the displacement is not corrected. The same manipulation is performed if the patient is under an anaesthetic, the internal rotation being maintained until extension is complete. In reducing displacements or breaking down simple adhesions, the finger should be firmly pressed upon the painful spot. The adhesions can usually be felt to give below the finger.

If the adhesions are firm the patient should be laid on his face with the front of the thigh resting on the table—both hands can then be used to flex and rotate the joint.

In dealing with the adhesions which follow fracture of the lower part of the femur, the thigh must be well protected by splints and the flexion should be recovered by steady pressure.

The Foot.

There are so many conditions of the foot benefited by forced movement that I will content myself by mentioning only one. It is a type of foot always treated by the methods we apply to the falling arch. It is associated with the adolescent and the middle-aged, and although the feet are flat, the symptoms are due to other causes.

In concentrating upon deformity as orthopaedic surgeons, we are apt to pay unreasonable homage to the obvious. If a person complains of the foot, we are only too ready to rush to the conclusion that the inturned ankle or flattened arch is the Alpha and Omega. It matters little whether the good foot is more deformed and without pain, or that the site of pain is anything but classic. Metal arches, crooked heels and cheery optimism, however, have their limitations. How rarely do we find a perfectly formed foot, and how often we find perfect function with faulty alignment. This should teach us to be humble and observant. I will describe two clinical types which, perhaps, you have already observed.

A middle-aged woman complains that her foot has broken down. She tells us she has always had flat foot. She never remembers hurting it, but admits that during the war she has had to stand a great deal. Her trouble has lasted twelve months, and she has undergone most types of treatment. Plates give her some relief, but the pain is sometimes very severe. She has pain over the dorsum of the foot and along the plantar fascia—sometimes under the deltoid ligament. She is fretful and irritable. The foot is painful on manipulation, especially over the upper part of the dorsum or when it is twisted. It has been labelled "static flat foot," and "rheumatic" flat foot. She never remembers having rheumatism.

We break down adhesions under an anaesthetic,—systematically attacking every articulation. We hear and feel them give. Massage, exercise and normal boots, in a few days, complete her cure.

A young man eight months previously was trodden upon by a horse. No fracture of any of the bones could be found. He had not been able to play any games since. His foot was flat and painful, especially over the scaphoid and cuneiform. There was a swelling over the dorsum which varied from time to time. The case was diagnosed as adhesions on the dorsal aspect of the mid-tarsal joint, and it reacted at once to treatment.

The more I have realized the fact that adhesions are often the source of pain in certain types of flat foot, or foot strain, the more interesting and even dramatic the sequences of events. There is the greatest difference between a calculated rupture of adhesions and the practise of passive movements. In one case the foot is irritated; in the other, it is released from bondage.

I may, perhaps, be excused for bringing before so expert an assembly a subject such as I have chosen, but I do think more attention should be given in our literature to a branch of work very much ignored and very little understood. It seems strange that I, an apostle of rest and immobility, should preach a sermon upon the advantages of movement. The doctrine that an inflamed joint requires rest is beyond discussion, but we should endeavor to draw a distinction between the real and the apparent, and not allow caution and timidity to obscure our critical faculties.

FRACTURES OF THE ELBOW IN CHILDREN.

BY JAMES S. STONE, M.D., F.A.C.S., BOSTON.

In this paper consideration is confined wholly to fractures of the lower end of the humerus. Fractures of the head of the radius, of the olecranon process, or of the coronoid process, or avulsion of the surface of the coronoid by action of the brachialis anticus are merely mentioned.

So far as routine treatment can be laid down, what should be done with the usual transverse supra-condylar fracture? Reduction under full anaesthesia, either before there has been great infiltration of blood through the soft parts or after this has begun to subside. In no case without sufficient reason should there be delay of over a week or ten days. In two weeks reduction by manipulation has become more difficult as a result of beginning organization in the tissues. Reduction should be attempted with the elbow fully extended, if necessary slightly hyperextended. With the upper arm held firmly by an assistant, strong traction is applied to the supinated forearm. It is usually necessary in addition to fully extending the forearm to rock the fragment into place by moving the wrist first to the radial and then to the ulnar side. More especially is it necessary to rock to the radial side to bring the inner side of the fragment into position. While traction is still maintained the elbow is to be fully flexed. If this can be done without hindrance and if there is no tendency to displacement when the forearm is lowered to a right angle, reduction is generally satisfactory.

The elbow is then held flexed midway between pronation and supination by strapping wrist to shoulder with adhesive plaster and adding the support of a sling. One strip of adhesive should lie inside the arm and wrist. The second should be outside. It is of the utmost importance that two pieces be used rather than one and that, especially about the arm, both lie smoothly so that the upper edges are under no greater tension than the lower. A triangular sling the long side of which is passed between the elbow and the body and the points of which are then brought round the neck in a figure of 8 is perfectly satisfactory. The angle at the elbow may be pinned up. In this way the joint is left wholly accessible to inspection and to care against maceration of the skin in the flexed surfaces which must be kept apart by a layer of gauze.

The flexed position should be maintained for two weeks. Then a change to a right angle splint for at least three weeks and for a sufficiently longer period if necessary to do away with all reflex spasm. Then a sling for a week as a safeguard against accident, and then natural use in play. This is the routine. Within six or eight weeks, motion will be fully restored unless possibly in the last few degrees in the extremes of flexion and extension.

Passive motion is either useless or harmful. We are considering fractures in children. In the joint of a child, there is not only the synovial cartilage but there are the large masses of epiphyseal

cartilage which tend to prevent rough jagged ends of bone from traumatizing the delicate synovial membrane. Fibrous intra-synovial adhesions, though frequent in fractures in adults, are practically unknown in children. There is therefore no need of passive motion to break up joint adhesions.

The two causes of limitation of motion after elbow fracture in children are first, spasm, and second, deformity. Spasm indicates one thing, that motion would cause pain. It is nature's demand for rest, and rest must be given till spasm is gone. Time and again, fractures in which the splints have been omitted before the spasm has gone, come in with an extremely restricted range of motion. Two weeks of absolute rest in splint and sling will show double or treble the range of motion immediately on removal of the splint as compared with what existed when the splint was applied. Spasm means that the callus is not firm. Every movement irritates the callus, microscopic capillary hemorrhages occur. There is an increased tendency to proliferative new bone formation. The callus instead of solidifying and shrinking becomes larger and not firm. I have seen cases in which continued forced passive movement under an anaesthetic led in time to complete bony ankylosis with absorption of the synovial cartilage. Passive motion under such conditions is absolutely harmful and inexcusable. Reflex involuntary spasm always demands rest. The restriction of motion by spasm is comparable to the limitation in the motion of a door owing to rusty hinges. Continued pressure causes continued yielding. There is no clean cut limit to the range of motion.

Deformity is the other cause of limited motion. The limitation is clean cut, definite, comparable to the stopping of a door by an obstruction. Primarily of course the deformity is bony, in part the result of imperfect reposition of the fragments, in part of callus formation. But secondarily, there may be all sorts of ligamentous and muscular readjustments which limit motion.

In overcoming deformity the decrease in the size of the callus, the gradual absorption of bony projections, and growth, and adaptive changes are the essential factors. Undoubtedly passive motion helps to attain all these objects, but if gentle, passive motion does no more than the child does constantly in active play. If the passive motion is more violent it may possibly do a little good, but at the expense of a tender arm which the child will refuse to use naturally for several hours. Passive motion is either harmful or useless in elbow fractures in children.

In cases of deformity, even of marked degree, it is amazing how rapidly an excellent functional result is attained. It is, however, common in fractures involving the internal condyle to observe a loss of the carrying angle even when full flexion and extension are possible.

In very rare cases, there persists a marked loss in the range of motion, but even in these cases, time is a great factor for recovery if one can only be patient enough. Repeated tracings of the range of motion, taken at three or four-month intervals, usually show steady progress. If progress finally ceases, the question of operative interference arises. As a rule any attempt to increase motion by trimming off projecting edges of bone is a disappointment. Only one factor among many is removed. Two other courses are open, one by supracondylar osteotomy to transfer a given arc of motion from a less useful to a more useful range. The other is an arthroplasty or a resection. As a rule none of these procedures should be undertaken while the factor of growth is still to be considered.

In a certain number of cases attempts at reduction by manipulation fail. Attempts may be repeated, but not oftener than once or twice, and especially must repeated attempts at reduction be avoided after the fracture is two or three weeks old. By that time new bone has begun to proliferate from detached periosteum, and the greatest care is necessary to avoid the spread of this new bone among the soft parts.

If perfect reduction is possible, then the choice must be definitely made between open reduction and letting alone. The question resolves itself largely into whether better reduction can be secured by incision than is already attained, and if better, how much better functional results will be attained. In general, the more skilled a surgeon becomes in the manipulation of fractures, the fewer cases of elbow fracture in children will he wish to open. If operation is undertaken only absorbable sutures should be used, and preferably they should involve only periosteum and fascia. In maintaining apposition the flexed position should be the main reliance. An anterior incision is for this reason undesirable. When the elbow is flexed the chance to dress the wound is poor. Maceration of the skin with the possibility of infection will occur.

One group of cases requires open reduction, those in which the epiphysis of the external condyle has been detached and has turned turtle. The slightly concave fractured surface points upward, outward, and backward. The articular surface lies in contact with the fracture line at the lower end of the shaft. Replacement by manipulation is usually impossible. The fragment has been locked beyond

a dead center. Through an external incision exposing the fragment it may readily be pried into place with a blunt dissector. There will be no difficulty in retention. A suture of the fascia and the flexed position insure a secure retention.

The operation may be done immediately before there has been great infiltration of the tissues. or later, after the swelling has begun to subside. If, for any reason, reduction has been unduly delayed, it is possible up to about six weeks after the injury to curette away the new soft callus which has grown out from the raw surfaces and restore the fragment to its normal position. Later on, however, the fragment becomes altered in shape, and the space from which it was torn fills in with new bone. Under these conditions removal of the rounded fragment which is in the way and usually attached by fibrous tissue to the shaft is the best treatment.

Very rarely, a somewhat analagous fracture of the inner condyle occurs. The same principles of treatment apply if reduction by manipulation cannot be accomplished.

I wish to add a few words regarding the recognition of epiphyseal separations, especially those in which the epiphysis is loosened but not displaced. In these cases, the x-ray may often be wholly negative. The diagnosis must be made by the history, the disturbed function, and the local tenderness. Owing also to the slight subperiosteal hæmorrhage the supra-condylar ridge is apt to show a loss of clean cut sharp outline. Such cases must be immobilized at right angles but need not be kept at rest for so long a time as is necessary in the case of a complete fracture.

Volkmann's ischaemic contracture is one of the most serious and distressing complications of elbow fractures. It is, moreover, one which is difficult to excuse Any muscle deprived of its blood supply, whether by shutting off of the arterial supply, or by stopping of the venous return, or by pressure of bandages for a period of about six hours or less, undergoes a degenerative change from the complicated muscle cells to low grade scar tissue. Contraction of the scar causes flexion of the muscles. The muscle cells not actually destroyed are caught in a mass of contracting scar tissue. The anterior muscles of the forearm are peculiarly liable to this distressing condition. In addition to the involvement of the muscles the scar tissue may by pressure impair the median and ulnar nerves, thus affecting the strength of the intrinsic muscle of the hand.

Within a year I have reduced a fractured elbow, placed it in acute flexion and found an immediate cessation of the radial pulse and a

blanching of the forearm and hand. Immediate incision and exposure of the line of fracture failed to show just how the artery was pinched.

Obstruction to venous return through traumatic thrombosis may cause tremendous congestion of the muscles of the forearm. For the relief of this condition, J. B. Murphy advocated incision of the sheath of the muscles. Personally, I have never seen a case requiring this.

Too tight bandages or bandages becoming too tight after swelling has occurred is the common story. Anticipation of this possibility and the warning to slash all restricting bandages at once will obviate many a condition which otherwise will be crippling to the patient and an everlasting plague to the surgeon. In the face of threatened blood supply to the muscles of the forearm, the position of the fragment is of very minor importance. Blood supply can never wait; position can wait.

The treatment of the condition is not within the scope of this paper. The prevention alone is considered, and to the surgeon setting the fracture, it is enough.

ARTHRODESIS OF THE SACROILIAC JOINT. A NEW METHOD OF APPROACH

BY M. N. SMITH-PETERSEN, M.D., BOSTON, MASS.

Up to the present time, operative work on the sacroiliac joint has been decidedly unsatisfactory. The reason is quite plain; the joint is very deeply located in a region which excludes any approach from anterior and superior aspects. This leaves only two possible avenues of approach; the posterior and the lateral. The different methods of approach from the posterior aspect all offer great difficulties, and only in the case of Dr. Painter's[1] approach is an actual exposure of the joint accomplished. Dr. Painter's approach, which consists in turning back a flap of bone from the posterior portion of the ilium, is too extensive to undertake except as a last resort.

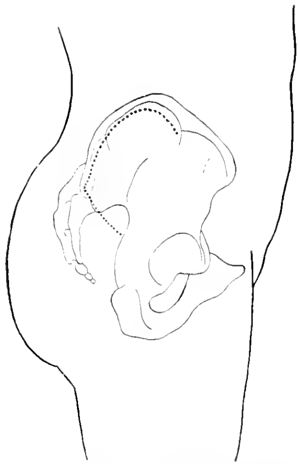

FIG. 1.—Dotted line represents incision in its relation to the ilium; curved limb of the incision extends from the posterior superior spine two-thirds of the distance to the anterior superior spine. Straight limb from the posterior superior spine in the direction of the fibers of the gluteus maximus muscles for a distance of approximately three to four inches.

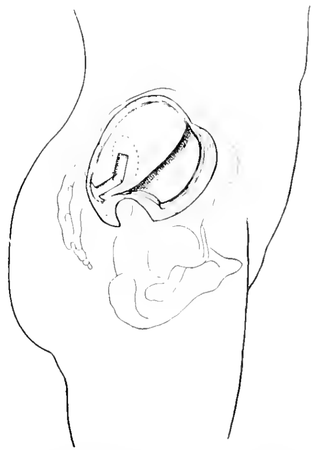

FIG. 2.—Flap reflected by subperiosteal dissection from lateral surface of the ilium. Dotted line shows sacro-iliac joint projected on the lateral surface of the ilium with windows cut in two different planes.

How about the lateral approach to the joint? What chance of exposure does this allow? In the literature on the sacroiliac joint, no article or reference to this route has been encountered, and yet it seems the most logical approach. This method has been used in a number of cases during the past three years, and the experience of the operator has been the same in every case: an anatomically easy approach with no trauma to important structures, resulting in good exposure of the cartilagenous joint surfaces of the ilium and the sacrum. The principle of the operation is similar to that described for the hip joint,[2]—a sub-periosteal approach.

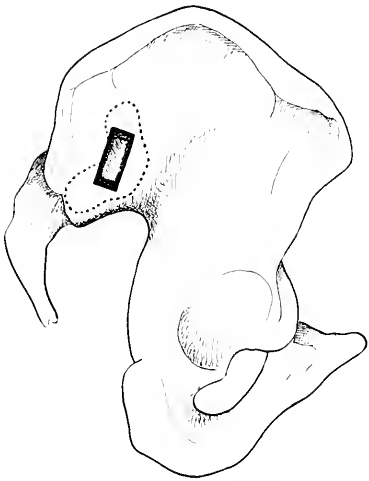

FIG. 3.—Dotted line represents sacroiliac joint projected on the lateral surface of the ilium. Window removed as described for cases of tuberculosis or of relaxation of the sacroiliac joint. Note that the window is well posterior to the median gluteal line and just above the sacro-sciatic notch.

The steps of the operation are as follows:

1. Curved incision from the posterior superior spine along the crest of the ilium, two thirds of the distance to the anterior superior spine. This incision is carried down to the bone and the reflection of the periosteum started. (Fig. 1.)

2. Incision from the posterior superior spine in the direction of the fibers of the gluteus maximus for a distance of three to four inches. (Fig. 1.) This incision is carried down through the subcutaneous fat and gluteal fascia and the muscle fibers of the gluteous maximus separated by blunt dissection, until the junction of the ilium and sacrum between the posterior superior and posterior inferior spines is reached. In carrying out the dissection, one point should be kept in mind: the superior gluteal nerve and artery emerge at the anterior portion of the sacro-sciatic notch and give off posterior branches which are en-

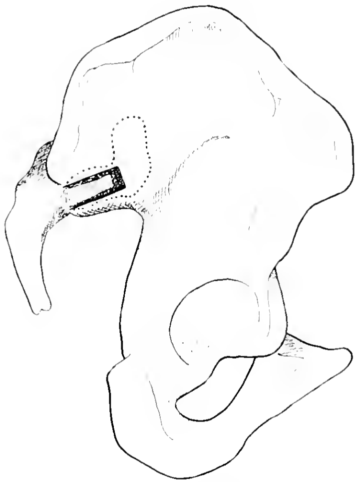

FIG. 4.—Dotted line represents sacroiliac joint projected on the lateral surface of the ilium. Window removed as described for cases of osteomyelitis: from posterior border of the sacroiliac joint between posterior superior and posterior inferior spines. It runs anteriorly parallel with the sacro-sciatic notch.

countered by the straight limb of the incision, and sometimes cause considerable bleeding. They have to be sacrificed in order to get a satisfactory reflection.

3. The flap thus outlined is reflected sub-periosteally, exposing the posterior portion of the lateral surface of the ilium. (Fig. 2.)

4. If the sacroiliac joint is projected on the lateral surface of the ilium, it will be found that the inferior border corresponds with the sacro-sciatic notch, and the anterior border with the median gluteal line. (Fig. 3.) The superior border is not of importance, because the two above landmarks determine the location of the joint sufficiently. A window is now cut through the ilium within the projected area of the joint. (Fig. 3 and 4.) A window, rectangular in shape, has been used in the majority of cases. (Fig. 3 and 4.) The thickness of the ilium just above the sacro-sciatic notch is considerable, sometimes as much

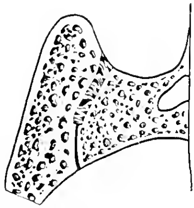

FIG. 5. (*a*)—Cross section of sacroiliac joint and of the posterior sacroiliac ligament.

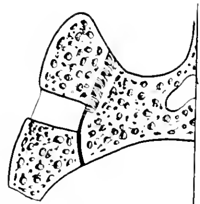

FIG. 5 (*b*).—Window removed from ilium down to joint surface.

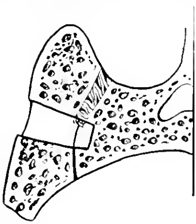

FIG. 5 (*c*).—Cartilage removed from joint surface of the sacrum as well as underlying cortex, exposing cancellous bone.

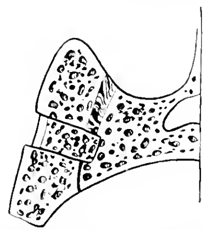

FIG. 5 (*d*).—Window replaced. It bridges the joint and cancellous bone is in contact with cancellous bone.

as an inch, but if care is taken, the entire block of bone from the outer to the inner table of the ilium may be removed in one piece. The operator is rewarded for his labor when, upon removal of the window, the cartilaginous joint surface of the sacrum comes into view. (Fig. 5B.) The cartilage of the sacrum as well as its cortex is next removed, bringing about a good exposure of cancellous bone. The above procedure results in a rectangular channel bordered on all sides by cancellous bone, extending from the ilium through the sacroiliac joint into the sacrum. (Fig. 5C.)

5. After removing the cartilage and cortex from the block of bone removed from the ilium, this is replaced in its original site and countersunk, so that its cancellous surface will be in contact with the cancellous bone of the sacrum. (Fig. 5D.)

6. The flap is now returned to its place and periosteum and soft parts sutured in layers.

The position of the window should be varied according to the ease

encountered. In purulent infections of the joint, the window is cut in a direction parallel to the sacro-sciatic notch; this will give efficient drainage of the joint. (Fig. 4.) In cases of tuberculosis, it is better to cut the window at an angle as a better dowel is thus obtained. (Fig. 3.) This, of course, also holds true in cases of sacroiliac relaxation.

In cases of tuberculosis, the above description and diagrams do not hold absolutely true, as the curette has to be used extensively to reach the parts of the joint not actually exposed. Seven cases of tuberculosis of the sacroiliac joint have had arthrodesis of the above type during the past three years, with uniformly gratifying results. Cases of relaxation of the sacroiliac joint which have had the above type of arthrodesis performed, have also been uniformly successful. They are, however, only six in number, three of them too recent to judge.

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[1] Boston Medical and Surgical Journal, Aug. 13, 1908, page 207.
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THE APPLICATION OF MUSCLE PHYSIOLOGY TO THE TREATMENT OF PARALYSIS.

BY LENNOX G. TEECE, M.D., CH.M., SYDNEY, AUSTRALIA.

WITH the gradual evolution of tendon transplantation from the position of an experimental surgical procedure to that of a soundly established method of coping with irreparable paralyses, greater attention has been focused on the physiological problems involved in the operation. In its earliest days, the mechanical aspect monopolized the attention of surgeons to the exclusion of other considerations, with the result that many operations were performed that we now realize to have been surgically unsound. The pioneer operation of Lange of transplantation of the peronei into the tendo Achillis for the relief of paralytic calcaneus, particularly instanced the neglect of the first mechanical consideration, in that in this operation the transplanted muscles were much weaker than those whose function they attempted to assume. This obvious mechanical deficiency of plan quickly attracted attention, so that we soon found Codivilla and others compil-

ing tables giving the relative power of the muscles of the extremities and drawing attention to the necessity of selecting sufficiently strong muscles for the purpose of transplantation. As time went on, the physiological aspect received increasing notice; the desirability was emphasized of selecting the muscles to be transplanted from the same synergic group as the paralyzed ones and greater attention was paid to the after-treatment and to the education of the transplanted muscles, though this latter point will never receive its due meed in those centres where this operation is in the hands of surgeons unequipped with proper orthopaedic training.

Finally, in recent years, the most notable advance has been due to the work of Mayer and Biesalski, as well as to that of Steindler. The former's discovery of the importance of the preservation of the gliding mechanism of the tendon and the latter's researches into the nutrition and vitality of the transplanted tendon have further served to direct our notice to the supreme importance of devoting minute consideration to all the physiological aspects, when planning any operation of tendon transplantation. The purpose of this article is to emphasize one such aspect that, in the opinion of the writer, has not received its due share of consideration. In order to secure the most fruitful results, it is necessary that the surgeon should be possessed of a complete knowledge of the different properties of muscle function: he must know and take into his reckoning not only their action as prime movers, but also their synergists and antagonists, and the occasions on which they act as fixation agents. Our present purpose is to examine the practical application of the recent advances in our knowledge of muscle physiology to the needs of the orthopaedic surgeon.

As a result of the war, we have delved into a storehouse of infinite clinical material, the results of the battle casualties, and in it we have found a hitherto unequalled collection of peripheral nerve injuries, injuries so varied in type that we have encountered sharply localized paralyses of every individual nerve trunk, and even of the branches to individual muscles and groups of muscles. Thus we have been enabled to enlarge our knowledge of the individual action of most of the muscles of the extremities, and to apply our knowledge to the elucidation of the problems, not merely of peripheral nerve injuries, but also of infantile paralysis, of which the victims are always with us, be it peace or be it war.

The fundamental essentials of the treatment of every type of paralysis may be grouped as follows:

1. A thorough understanding of the function and action of the individual muscles.

2. An accurate determination of the muscles that are paralyzed and their possibilities of spontaneous recovery.

3. The methods of encouraging the recovery of voluntary power, such as reëducation, massage, and electricity.

4. If the paralyzed muscles are incapable of recovery, can their functions be assumed spontaneously by other muscles, or can other muscles be trained to take upon themselves the responsibility of the lost function? In default thereof, will surgical intervention, by altering the function of certain muscles, suffice to restore in part at least the deficient movements?

Consider first the functions and actions of individual muscles. This subject is far more complex than it appears at first sight. Primarily, let us state that each muscle possesses two opposite functions, contraction and relaxation, and as emphasized by Colin Mackenzie in his book, "The Action of Muscles," these two functions can only be exercised at different times. Relaxation is as much an active process as contraction and is just as much the result of a nervous impulse. When down the path of the motor nerve there travels an impulse to a muscle to contract, there simultaneously travels to its antagonist an impulse to relax, and *pari passu*, these two active physiological events occur. This is the explanation of the smooth, even nature of human muscle movements as opposed to the jerky movements of an automaton. Illustrative of the necessity of this active physiological relaxation is the condition of hyperextension of the knee-joint, which sometimes develops in cases of quadriceps paralysis. This is the result of the patient actively producing complete relaxation of the hamstrings at the moment that he commences to swing the leg forward. It swings forward with considerable impetus as it is unchecked and uncontrolled by the normal gradual relaxation of the hamstrings that should occur. Thus it swings till the knee locks in full extension and the repeated jar at length leads to stretching of the posterior ligament of the joint and hyperextension of the knee. Thus the physiological purpose of active muscle relaxation is to act as a brake on muscle movements and to protect the ligaments of joints from overstrain. The inability of a muscle to be simultaneously in a state both of contraction and relaxation may be visually exemplified by studying the action of the dorsal interossei muscles of the hand. The action of these muscles is to extend the two terminal phalanges of the fingers. If the finger be held firmly flexed at the first interphalangeal joint, so that consequently the dorsal interosseous mus

cle is relaxed, then any active voluntary extension of the terminal phalanx becomes impossible. The muscle being actively relaxed to allow of the flexion at the first interphalangeal joint cannot at the same time pass into a state of active contraction to extend the terminal phalanx. Though the physiological contraction of a muscle is normally accompanied by the physiological relaxation of its opponents, under certain conditions of functional disease this may not be so. In some cases of functional paralysis, the disability is due to the fact that an attempt to contract one group of muscles evokes not a relaxation, but a simultaneous contraction of its antagonists, with the result that no movement takes place in either direction. Furthermore, we must distinguish between relaxation and elongation. Here again we may quote Mackenzie: "Elongation of muscle is not a physiological action, but is produced as a result of a mechanical action; relaxation is essential for elongation and must precede it, but there is no inherent force in a relaxed fibre that produces elongation." For example, in the case of a paralytic wrist drop, the extensors are relaxed, even though the wrist be supported on a cock-up splint; remove the splint, and the force of gravity immediately elongates the paralyzed muscles, which are now both relaxed and elongated. Relaxation is never harmful; prolonged elongation invariably is.

Next let us consider together postural length, postural tone and muscle elasticity. Normal muscle possesses a considerable amount of elasticity, by virtue of which it adapts itself to movements of joints over which it passes but on which it does not act. Let us examine the extensor communis digitorum in this light; this muscle passes over but does not act on the wrist joint. Strongly extend both wrist and fingers; while still holding the fingers extended, flex the wrist. Then the extensor communis digitorum, though it has remained in strong contraction all the time, has had its total length, from origin to insertion, increased by this second movement, and its adaptability to this alteration in the distance from origin to insertion without lessening its contraction, is due to its elasticity. Thus elasticity is quite distinct from contractility.

Every muscle has its normal postural tone and postural length, the latter dependent on the former and both subject to alteration in disease. The postural length of any muscle is the length that muscle assumes when both it and its antagonist are in a state neither of active contraction nor of active relaxation; that is, are in equilibrium. The postural length is chiefly dependent on that peculiar inherent quality of muscle known as tone; it is tone that gives that distinctive resilience to touch

to a normal muscle as compared with the flabbiness of paralyzed muscle. It is due to tone that when a muscle contracts it at once commences to produce the movement for which it is designed, so that there is no time lost in taking up slack before the contraction becomes effective. Also affecting postural length is the condition of the other constituents of muscle apart from muscle fibers, namely, the muscle sheath and intermuscular connective tissue; it sometimes happens as a result of prolonged overstretching that a muscle, while still retaining its power of contractility under voluntary control assumes a new postural length greater than its normal, and it then conversely occurs that at the same time its opponents acquire a new postural length less than the normal. This frequently happens in cases of wrist drop that have recovered in spite of neglect of adequate splinting; in such cases there may be—provided we can neglect ligamentous opposition to movement—full muscular contractility and a range of movement, as measured in degrees, equal to normal, but movement from a position of hyperflexion to one of less than full extension. Thus in cases of functional paralysis the last step in the march to recovery is usually the restoration of normal postural length. The subject of a functional wrist drop, who has so far recovered as to perform full movements, will frequently be noticed to carry his wrist in marked flexion when the part is inactive and his attention distracted elsewhere. This is because the altered postural lengths,—lengthened extensors, and shortened flexors,—now have their position of equilibrium a position of flexion of the wrist instead of the normal position of equilibrium which is the mid-position. Loss of tone of a muscle frequently results in the assumption by it of a postural length greater than normal, and loss of tone in greater or lesser degree is an invariable accompaniment of muscle injuries. This includes the unavoidable muscle injury inflicted during the performance of a tendon transplantation and is a strong argument for the necessity of gentle handling. We have all noticed how, after injuries to the muscle substance of the flexors of the fingers, for some time finger flexion remains incomplete, even after the commencement of this movement has become powerful. The delayed restoration of the last few degrees of this movement is due to the injury causing loss of tone, which has resulted in an increased postural length of the muscles so that when contraction is complete for the new postural length, the origin and insertion of the muscles are farther apart than they should normally be and the fingers are therefore not completely flexed.

Having considered the vital endowments of muscles in general, let

us now pass on to deal with their functions, both individual and interdependent. As Wood Jones has clearly pointed out, these functions are four in number: (1) prime movers; (2) antagonists; (3) synergists; (4) fixation agents.

1. Their Action As Prime Movers.

This, the simplest action of muscle, requires no elaboration except on one point. Thus the action of the brachialis as a prime mover is to flex the elbow joint. But we may ask, does each muscle possess one and only one function as a prime mover, or may it perform different movements? Take the example of the biceps brachii, on the subject of whose functions much disputatious ink has been spilt. Is it a flexor of the elbow, or a supinator, or is it both? Mackenzie stoutly maintains that each muscle is a specialist in function, having one and only one duty to perform, and having correspondingly fixed antagonists, which actively relax when, and only when, the first muscle contracts. He would have us believe that the biceps is a supinator only, that its action calls into active relaxation the pronators, that it has no action as a flexor, partly because its action will not call forth a simultaneous relaxation of the triceps, the antagonist of elbow flexion. Mackenzie has done a great service in drawing attention to the science of muscle action, in defining the zero position for muscle reëducation and generally in insisting on the value of this method of treatment which was in danger of being neglected for the more popular massage and electricity. Nevertheless, we must not let his very real achievements blind our eyes to the extent of accepting the evident fallacies as to muscle action, which he has endeavored to endow with axiomatic significance. There is no shadow of doubt that many muscles possess more than one function as prime movers, and we can assert this without denying the principles of antagonism, but modifying Mackenzie's statements by holding that the muscles are provided with a different set of antagonists for their different functions. Let us quote the example of a single muscle, whose action entirely controverts Mackenzie's views. The flexor carpi ulnaris, according to him, is a flexor of the wrist, whose antagonists are the radial extensors and the extensor carpi ulnaris, which must be relaxed when the flexor carpi ulnaris contracts. But perform the movement of ulnar adduction of the hand by mere palpation of the part, it is evident that this is a movement produced by the combined action of the flexor carpi ulnaris and the extensor carpi ulnaris with simultaneous relaxation of the radial extensors and the flexor carpi radialis. Here, then, we have acting to

gether two muscles, which Mackenzie declares to be reciprocally antagonistic. Therefore, the separate functions of muscles are associated with separate synergists and separate antagonists. The conclusive explanation and reconciliation of divergent views is as follows: "When a muscle is actively relaxed to such an extent as to allow full action of its antagonists as regards one pair of reciprocal movements, it can not pass into a state of contraction to bring about the other movement of which it is capable and for which it may have different antagonists and synergists, so long as the first antagonists remain in a state of full contraction." Thus the biceps brachii is both a flexor and a supinator, its respective antagonists being the triceps and the pronators; then the biceps cannot flex the elbow when the forearm is held in a position of strong active pronation, nor can it supinate the forearm when the elbow is held fully and actively extended. Again, the flexor carpi ulnaris cannot ulnar adduct the hand when it is held fully extended, nor can it flex the wrist when the hand is held strongly actively abducted. Were the views which have been put forward as to the specialization of muscle function to be accepted, the process of muscle reëducation in cases of recovering paralysis would be greatly simplified. In fact, in some quarters, the acceptance of these views has resulted in misapplied efforts of reëducation and unwarranted optimism as to recovery. In such cases, recovery has been confidently proclaimed in muscles which were still completely paralyzed, the observer being deceived by the assumption of new functions on the part of unaffected muscles, which had taken on themselves the duty of the paralyzed ones. It is, therefore, imperative while reëducating muscles, to be constantly on the watch to be sure that it is they which are contracting and that the movement so obtained is not merely a so-called substitution movement performed by an unaffected muscle. For example, in cases of median and ulnar nerve paralysis, patients frequently learn to flex the wrist by the agency of the extensor ossis metacarpi pollicis.

2. Their Action As Antagonists.

Having dealt with the action of muscles as prime movers, there remains little to be said of their action as antagonists, these two actions being mutually interdependent. The action of muscles as prime movers is entirely under voluntary control; their action as synergists or as fixation agents can, by a process of education, be largely brought within the same category; on the other hand, the relaxation of its antagonists on the contraction of any muscle is not an action of which the

cortex of the human brain has any active knowledge; it is unconscious, automatic and can be neither governed nor regulated by the patient's will. This fact is of great importance in connection with the education of cases in which the operation of tendon transplantation has been performed. The transplanted tendon may be so inserted as to perform a function entirely different to its previous one, that is, we can alter the function of a muscle as a prime mover; then the muscles which were previously its antagonists and relaxed when it contracted, will still do so even though their action is no longer antagonistic to the new function of the transplanted tendon. Sometimes this is of slight importance. For example, when in cases of paralysis of the posterior interosseous nerve the flexors carpi radialis and ulnaris are transplanted into the extensors of the fingers and thumb, their new action of extending the fingers and thumb is accompanied by reciprocal relaxation of the wrist extensors, their former antagonists. Therefore, such cases cannot simultaneously powerfully extend the wrist and digits. Still, in this case, the disadvantage is minimal, for in practice it is found that on extending the digits while the wrist is extended there merely occurs some slight lessening of wrist extension, it does not drop forward into complete flexion. In some cases, however, the relaxation of previous antagonists may considerably mar the success of the operation. Again, to quote the previous example of posterior interosseous paralysis, if the flexor carpi ulnaris be transplanted into the extensor carpi ulnaris, its action as a wrist extensor will be ineffective, because when it contracts to extend the wrist, the radial extensors of the wrist will relax. Therefore, in planning any procedure of muscle or tendon transplantation, due regard must be paid to the question of antagonism.

3. *Their Action As Synergists.*

The vast majority of the movements of the human frame are the result of several muscles acting in synergism, and it is but seldom that an isolated contraction of a single muscle occurs. Though synergism is the normal action of muscles, it is quite possible, by education and practice, to dissociate the muscle action of the individual members of a synergetic group. A large part of the preoperative and postoperative education of a case of tendon transplantation consists of the educative dissociation of the action of synergists. Thus in a case of localized paralysis of the extensor longus pollicis, we may transplant the flexor carpi radialis into it and we must then train the patient to contract the flexor carpi radialis without a simultaneous contraction of the

flexor carpi ulnaris or else extension of the terminal phalanx of the thumb will be invariably accompanied by wrist flexion. Great as is the desirability of selecting a synergic muscle for transplantation, to replace a paralyzed one, in some quarters undue emphasis has been attached to this point. Of greater importance is it to avoid selecting for transplantation a muscle whose normal action is antagonistic to the new one it is desired for it to assume.

4. *Their Action As Fixation Agents.*

In the exercise of this function, one or more muscles fix a joint to facilitate the action of some other muscle or muscles. Generally speaking, for strong action of the muscles controlling the movements of the distal joints of a limb, it is essential that the proximal joints should first be fixed by the muscles which control them. For powerful use of the forearm and hand, it is necessary that the subject should have sufficient muscle power and control to fix the shoulder joint. Thus in paralysis of the upper extremity, attention must be focused on securing a reasonably stable shoulder joint. Where this extremity has to be dealt with by two operations, the primary one should be directed to the shoulder. The action of muscles as fixation agents is under voluntary control and transplanted muscles can be taught to acquire new functions in this respect.

The following are the chief points of practical interest to the orthopaedic surgeon in the application of these principles of muscle physiology:

(a) It is desirable that before operation the patient should undergo a short course of muscle training and education. He should be taught the position and action of the muscles concerned, to appreciate the sensation conveyed to the brain by the contraction of muscle, to contrast the characteristic hardening of a contracted muscle with the flabbiness of a relaxed one. He should learn to dissociate the action of individual muscles from that of their synergic fellows. This preliminary enlistment of the patient's coöperation will considerably shorten the postoperative reëducation period and will encourage him to practise the new functions of his transplanted tendons at times apart from those when he is actually undergoing treatment at the hands of the physiotherapeutist. Furthermore, it will eliminate the possibility of the education of trick substitution movements, for he will be guided not merely by seeing the desired movement occur, but also by realizing the sensation of contraction in the proper muscle.

(b) It has long been recognized that any deformity present should

be corrected before transplanting tendons; we can go further and assert that after correction the part should be held in the corrected position for some time before the operation is performed. The unaffected antagonists of the paralyzed muscles will have acquired a postural length less than normal as a result of long continued deformity. Therefore, time must be allowed them to regain their normal postural length, and this is not an immediate process; with appropriate splinting, they are at first merely stretched and elongated; gradually, however, as a result of this stretching, they reassume their old normal postural length. If this precaution be not taken, we measurably increase the early task of the transplanted tendons, for they initiate their new sphere of action under the handicap of being forced to pull against muscles with a shortened postural length.

(c) In selecting muscles for the purpose of transplantation, it is preferable to choose those which normally are synergists of the paralyzed ones. Failing this, choose muscles which, though not synergic, are yet of such situation and strength as to render it probable that they will function satisfactorily in their new position. Above all, avoid transplanting tendons in such a manner that they will be called upon in their new position to work in conjunction with former antagonists.

(d) Avoid transplantations of too complex a nature. In complex operations, success is entirely dependent on the patient's susceptibility to reëducation. In patients of low mentality and in those of the hospital class, it is well to restrict transplantations to those of the simplest type, unless we can be certain of carrying out very prolonged and efficient after-treatment.

(e) Where the paralysis is so extensive as to involve all the segments of a limb and to cause instability of the proximal joints, it is best to fix these joints by arthrodesis before proceeding to transplant for the peripheral portion of the affection. By thus first atoning for the loss of the fixation agency of these joints, we increase the latent possibilities of the transplanted tendons and render their subsequent reëducation much easier, for during this latter process, the patient having a constant fixation of the proximal joints, can concentrate his entire attention on the action of the muscles that are undergoing reeducation.

(f) The work of Mayer, Biesalski and Steindler has directed attention to the necessity of careful handling of tendons during operative procedures for the purpose of preserving their gliding mechanism and of preventing damage to their nutrition. Further stress may be laid

on this point on account of the invariable loss of tone that follows any damage inflicted on muscle, and we do not desire to incur the loss of time that would be necessary to wait for recovery of tone before satisfactory reëducation could be obtained. It is not uncommon to find after operation, that the transplanted muscles temporarily lose their response to the faradic current; this is indubitably due to accidental stretching of the motor nerves during the course of the operation, and is a further argument for extreme gentleness. It is difficult enough to reëducate a normal transplanted muscle; we do not desire the added difficulty of dealing with one that is recovering from a paralysis inflicted by the surgeon's carelessness.

(g) Too much stress cannot be laid on the necessity of suturing the transplanted tendon under adequate tension, so that in its new sphere it will commence work with its normal postural length and will not have to laboriously acquire a new one. Indeed, when the common mistake is made of suturing the tendons under insufficient tension, they may altogether fail to acquire the necessary increase in postural length and consequently expend their energy in taking up their own slack instead of producing the intended movement.

In the postoperative treatment of these cases, I would emphasize the usefulness of the Smart-Bristow faradic coil. Full details of the technique of its use will be found in Mr. Bristow's book on joint and muscle injuries. It is invaluable in securing the first contractions in the transplanted muscles and can be regulated to produce contractions of the smallest amplitude. It is of particular assistance for reëducative purposes in giving the patient visual evidence of the new functions of the transplanted muscles.

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Current Orthopaedic Literature

STAVE FRACTURE OF THE FIRST METATARSAL BONE. M. B. Cooperman. *Annals of Surgery*, February, 1921, p. 215.

Cooperman reports a case of stave fracture of the first metatarsal and compares it with the stave fracture of the first metacarpal (Bennett's fracture) which penetrates into the joint with the trapezium, and is due to force acting on the end of the thumb. In stave fracture of the foot the fracture penetrates into the joint with the internal cuneiform, but is due to indirect violence transmitted through the foot from the heel, the metacarpal head being fixed by weight bearing on the ground.—*P. D. Wilson, Boston, Mass.*

DERANGEMENT OF THE SEMILUNAR CARTILAGE; OBSERVATIONS IN 76 OPERATIVE CASES. Louis Strahlmann and J. W. White. *Journal A. M. A.*, Feb. 26, 1921, p. 561.

In this article the authors state the following as their conclusions:

1. The most reliable diagnostic features in this condition are: (*a*) traumatic origin with recurring disability; (*b*) definite localized pain or tenderness; (*c*) "locking"; (*d*) sense of derangement or feeling of insecurity; and (*e*) swelling.

2. We believe that simple hypermobile cartilage is a definite entity requiring surgical treatment, and that it is more common than fracture of the cartilage.

3. As complete excision as possible is the operation of choice, and, with proper aseptic technique, can safely be performed.

4. Once the diagnosis is definitely established, prompt operative interference should be seriously considered, provided, of course, there is sufficient disability.

5. The prognosis should be more or less guarded in cases with long-standing symptoms and when, on operation, the cartilage is found to be lacerated or comminuted.

6. Operative results are better than statistics indicate, untoward results being due to the facts that, first, the deranged cartilage is only a symptom of an unrecognized, and sometimes undeveloped, condition such as a syphilitic or tuberculous joint; second, the original trauma and consequent atrophy cause a permanent injury to other joint structures in addition to the cartilage derangement, which is logically not improved by its excision; and third, too much of the cartilage is left in the joint either as an attached extremity or as fragments.—*Lloyd T. Brown, Boston, Mass.*

RECURRENT DISLOCATION OF THE SHOULDER JOINT; A MECHANICAL CONSIDERATION OF ITS TREATMENT. J. W. Sever. *Journal A. M. A.*, April 2, 1921, p. 925.

The author says that the only portion of the joint capsule of the shoulder joint is that portion between the insertion of the triceps on the lower edge of the glenoid fossa and the subscapularis above. This is the portion of the capsule which is supposed to be most frequently torn in these dislocations

and, as a result of this primary tear, there results a relaxation of this portion of the capsule, which allows subsequent and recurring dislocations, always, however, the result of unbalanced muscular effort. The atrophy of the above mentioned muscles, all of which have a direct action in keeping the head of the humerus in the glenoid cavity, would naturally lead to a loss of this control more or less great, and plus the presence of a weak, stretched or torn capsule, would establish an ideal condition for recurring dislocations.

Combine this with the forward pull of the lower portion of the pectoralis major on the head of the humerus in abduction and elevation, the position in which dislocation occurs, and the result must be another dislocation.

The author advises, therefore, complete division of the pectoralis major without subsequent suture, as well as a definite shortening of the tendon of the subscapularis. Capsulorrhaphy is not an essential feature.

Complete division of the pectoralis major has been done in about 40 cases with no untoward results. The arm can be abducted quite as well as before and no essential loss of function has been observed.—*Lloyd T. Brown, Boston, Mass.*

Typhoid Spine. Barclay Moffatt. *Jour. A. M. A.*, March 5, 1921, p. 639.

Report of a case of typhoid spine at the annual clinical conference of the Hospital for Ruptured and Crippled. The author quotes Murphy and others, but makes no mention of Rogers' article. He has nothing new to offer.

He comments that the interesting points seem to be: (1) the occurrence of lumbar pains; (2) the formation of a kyphosis, though the roentgenograms were negative; (3) the ease of reduction of deformity. This was done by plaster casts.—*Lloyd T. Brown, Boston, Mass.*

Dislocations of the Semilunar Carpal Bone. Isadore Cohn *Annals of Surgery*, May, 1921.

A presentation of one case which was treated by excision of the semilunar bone. The author reviews the anatomy of the dislocation, but presents nothing new. He states that in an extensive experience of ten years at the Touro Infirmary in New Orleans he has seen one case.—*P. D. Wilson, Boston, Mass.*

Bone Grafting: Study of Cases Operated Upon in U. S. Army Hospitals. J. B. Walker. *Annals of Surgery*, January, 1921.

This is a short article based on figures in the Surgeon-General's office and is inconclusive because of the incompleteness of the figures.

Records show that among 215,423 wounds in the American Expeditionary Forces, there were about 25,000 fractures, and of these, 15,165 were of the long bones. Thus far there have been reported 906 cases (6%) of non-union.

Of these, 611 were treated by bone grafts; 189 by Lane plates; 52 by suture with wire, and 54 with kangaroo tendon or chromic catgut.

The author concludes that it is reasonably safe to operate during the fourth month after complete healing. Autogenous grafts taken from the tibia have proven the best material for fractures of the long bones. Exact coaptation is necessary for success.

In the cases that have been rated for disability, 48% had 25% disability or under, 22% had between 25% and 35% disability, and 22% had between 35% and 50% disability. In 8% the disability was over 51%. Figures show that where the interval between injury and operation was less than two hundred days, a low disability of 25% was obtained in 43% of the cases; whereas it was obtained in 57% where the interval was over two hundred days.—P. D. *Wilson, Boston, Mass.*

NON-UNION OF HUMERUS: REPAIR BY MEANS OF BONE GRAFT. M. S. Henderson. *Southern Medical Journal*, February, 1921.

This study is based upon forty-one cases of non-union of the humerus. The cause of the non-union is stated to be imperfect immobilization in ambulatory splints. The author feels that his method of operative procedure and after-care is efficient. The author reviews the theories of osteogenesis promulgated by Ollier, who maintained that a graft without its periosteum died; by Radzimonsky, who contended that all transplanted bone dies, but that periosteum lives and may form bone; by Barth, in 1893, who advanced the theory that all the elements of bone die when grafted and that the graft is a scaffolding for the replacement of bone by the bone forming elements of the raw fractured ends of the parent shaft; by Axhausen; by Macewen in 1912, who regarded the periosteum as a living and limiting membrane; all these investigations that osteoblasts, wherever they be, under the periosteum, in the haversian canals, and especially in the exposed endosteum, are the means for completing the union and possible replacement of the graft with and in its bed; that periosteum, by establishing a speedy vascular connection, otherwise impossible, nourishes the graft while the process of internal reconstruction is going on. The osteoblasts are most abundant in the endosteal surface of the bone, and therefore there ought ideally to be wide apposition of endosteum to endosteum, and the graft must be sufficiently strong to withstand reasonable strain until the condition is wholly cured. For these reasons and because the massive graft satisfies him, the author advocates its use as against the intramedullary peg of Murphy, which is fundamentally wrong in principle, and the Albee inlay method, which does not supply a sufficient endosteal counterposition of bone elements. His statistics show 85% of good results with the massive graft; 70% with the inlay; 50% with the intramedullary graft. There is nothing new in the method of exposure; the graft is held by beef bone screws. A plaster jacket with arm in abduction is applied on the operating table, to be replaced in four to six weeks by an ambulatory, internal angular metal splint, depending upon the clinical evidence and x-ray examination.—*W. A. Cochrane, Boston, Mass.*

NEWS NOTES

DR. CLARENCE L. STARR of Toronto has been appointed Professor of Surgery at the University of Toronto and Surgeon-in-Chief to the Toronto General Hospital.

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The Journal *of* Orthopædic Surgery

ARTHROPLASTY.

DR. V. PUTTI, BOLOGNA, ITALY.

I trust that the President and members of this Congress to which I have had the great honor of being invited, will not accuse me of presumption if I dare to speak about the *surgical treatment of ankylosis* in the country which has given birth to Rhea Barton, the first who attempted an arthroplasty, nearly a century ago, and in the land of J. B. Murphy, of Baer, of Osgood, and of many other orthopaedic surgeons who were the pioneers in these researches which led to one of the greatest conquests of modern surgery.

I have been induced to make this choice, not because I presume to have anything new or interesting to say on the subject, but above all to render an act of sincere homage to American surgery and specially to its great master, the late J. B. Murphy, to whom we owe the immense progress made in the field of arthroplasty. Whoever at present wishes to discuss this subject cannot say more or better than J. B. Murphy has already said.

If I have decided to lay before you the fruit of my experience, I do so because I am quite convinced that it is the duty of those who have dedicated themselves with special activity to this subject to divulge the ideas and methods which have had for their first originator J. B. Murphy.

I need not insist on the utility of this propaganda before such a competent audience. In comparison with the scanty number of the convinced, there is still a numerous category of surgeons who, notwithstanding the innumerable proofs of the practical value of the

mobilization of ankylosis, discuss the indications and are skeptical before the most brilliant results.

This history of medicine shows us how difficult and slow is the divulgation of new ideas and methods.

But considering the injury that even a short delay in the generalization of arthroplasty may cause to a great number of patients, it is our duty to do our best so that every uncertainty and opposition may be quickly and definitely overcome.

Therefore it seems to me that even a modest contribution of facts well observed and sincerely set forth may attract the attention of those who have not yet attempted these methods. It is with this hope that I try to report to you the fruit of my experience.

My first arthroplasty dates from ten years ago. From that time to the present day I have performed 113 mobilizations of ankylosis, of which 10 were of the jaw, 1 of the shoulder, 38 of the elbow, 1 of the wrist, 2 of the fingers, 17 of the hip, 40 of the knee, 2 of the ankle-joint, 2 of the toes.

INDICATIONS AND COUNTERINDICATIONS.

At the beginning of the discussion of arthroplasty the first argument which must be taken into consideration is that of the indications and counterindications as to the surgical treatment of ankylosis. Thanks to the satisfactory results obtained by arthroplasty in these late years, the limits of the indications have become enlarged. For some cases the indication is absolute, that is, for ankylosis of the temporo maxillary joint, for the bilateral ankylosis of the hip, for that in extension of the elbow, for that which affects at the same time many joints of the same limb. For the other ankyloses the indications depend on the examination of several elements.

1. The general health of the patient, his age, his mental condition, his social state. It is quite evident that arthroplasty is never an essentially necessary operation. It is therefore the surgeon's duty to explain to the patient the risk he runs, and to operate only when he has the greatest certainty of success, and when he is sure that none but surgical means can cure the ankylosis. The patients who are not in perfect condition of organic resistance are not adapted to support an operation, which is always long, and to bear a postoperative treatment which may last for months.

As to the age, I have noticed that arthroplasty is not suitable for children and old people. The best age is from 20 to 50. It is easier

to be successful on a man of 55 than on a boy of 15. The reconstruction of a joint is so complex a phenomenon of biologic adaptation that it can attain success only when the work of a clever surgeon and the active coöperation of a willing and intelligent patient act together. We must therefore be prudent in proposing arthroplasty to a patient if we cannot thoroughly rely on his firmness of will to endure calmly the inevitable suffering, and on his tenacious perseverance in the post-operative treatment. Men, therefore, in this respect, are more adapted than women and children or subjects who are intolerant and irritable, and the mentally deficient are not less adapted than those who for secondary ends are not willing to be cured.

Also the financial state of the patient must be considered. If the technical progress achieved of late allows us to attain the result more rapidly, it is true that after the operation the patient must remain under the surgeon's care in the hospital for a long time. The after treatment of an elbow arthroplasty requires not less than six weeks, that of knee arthroplasty not less than twelve weeks. If the patient cannot financially afford this period of after treatment, we should not advise the operation. The arthroplasty must depend, too, upon the patient's occupation.

2. The etiology, the pathogenesis, the anatomical conditions, the duration of the ankylosis.

The post-traumatic arthritides are the best adapted to arthroplasty. When every orthopædic and physiotherapeutic means has been tried without success, and when the patient will not tolerate the deformity, the surgeons must propose the operation with faith in its good effect.

But we must not proceed too quickly. It is essential that the joint should be neither painful nor swollen. Experience shows that the treatment is much more successful in the bony than in the fibrous and painful ankylosis.

In the ankylosis after infectious arthritis the problem of the indication is much more delicate. It is necessary to distinguish the ankylosis from acute arthritis both primary and secondary, from that due to chronic processes, both mon-and polyarticular. The arthroplasty is much more likely to succeed in the former than in the latter. The reason is that the acute arthritis has a well defined course, whilst in some cases of chronic arthritis it is very difficult to judge when the infection is over. Now the arthroplasty should not be performed until we are quite sure that no trace of the primary disease exists. I consider it a fundamental principle of arthroplasty to postpone the opera-

tion for not less than a year from the time when all sensitiveness of the joint has disappeared.

We can judge precisely of the recovery of a gonorrheal arthritis, but when can we say we are sure not to awaken a latent infection in a tubercular joint? Notwithstanding the good results obtained by Baer and, in some cases, also by Murphy, I have operated upon only one case of tubercular ankylosis, an elbow, out of more than a hundred arthroplasties. I think that for the present ankylosis must be considered as the best result of a tubercular arthritis.

For analogous reasons the ankylosis due to progressive arthritis and that affecting many joints do not lend themselves to arthroplasty. Out of four cases of arthroplasty for bilateral ankylosis of the hip, after Marie-Strümpell disease, I succeeded in only one, and in another the result was moderately satisfactory. In the other two I had no success at all.

The ankylosis after war injuries must be considered apart. In these cases, we must distinguish the ankylosis after a direct injury to the joint from that due to a prolonged immobilization of the limb. These latter, of which the most frequent example is the ankylosis of the knee after an exposed fracture of the femur, are quite adapted to arthroplasty. In the former, if the wound is aseptic, we are in the same condition as in the common traumatic ankylosis. But this does not often occur. Much more frequently the ankylosis is the result of an infected wound, and therefore the indication as to an arthroplasty must be examined more attentively. The arthroplasty must not be proposed or performed unless we are perfectly sure that the infection is over, and we all know how difficult it is to judge of the complete sterility of the tissues infected by a war injury. The wounds must be completely healed, the fistula closed, not a sign of swelling, tenderness or pain must remain. The x-ray must assure us that sequestra or foreign bodies are not present. The ankylosis subjected to massage, hot air treatment and gymnastics, must not give any sign of reaction. We must not be in haste to operate; we must wait for months, and sometimes for years.

I have had excellent results in war ankylosis, but the few unsuccessful cases and the only case of death were due to a too precocious intervention.

It is generally thought that a too prolonged delay may be injurious to the functional condition of the muscles. That is true, but only to a certain degree. Clinical experience has shown us that muscles which

have remained for many years inactive can rapidly re-assume their normal function to a great extent.

In a case of ankylosis of the temporomaxillary joint dating back 15 years, I have noticed that the muscles have regained their function a few hours after the operation. From a certain point of view, an old bony ankylosis in which the muscles are atrophied is always preferable to a fibrous one in which the muscles are in good functional condition. In short, the aforesaid are the general indications of arthroplasty.

Now a few words about the special indications for each joint. It would be as much as to say that we did not recognize the great success of arthroplasty, if we denied that the field of action in this respect has been greatly enlarged. As I have already said, the indication must be considered as absolute for certain cases of ankylosis, that is to say, that of the jaw, the bilateral of the hip, and those in extension of the elbow. But who can deny nowadays that all the cases of ankylosis of the elbow, with due exception for their nature are adapted to mobilization? You know it is many years since Ollier stated that even the right-angular ankylosis must be operated upon.

I have seldom met with the necessity of operating upon an ankylosis of the shoulder, considering how easily the lack of movement of this joint can be compensated for by the articulations near it.

The ankylosis of the wrist must only be operated upon when the hand is rigid in palmar flexion. The arthroplasty of the fingers may be successful in some cases. The arthroplasty of the unilateral ankylosis of the hip, which fixed the joint in a position of deformity, may be proposed in every case in which the patient cannot accustom himself to the deformity or when there are reasons for not prefering the subtrochanteric osteotomy. In the bilateral ankylosis I think it is better to operate on one side only, although in four of my cases, I have operated on both sides, because the patients, satisfied with the first arthroplasty, requested a second operation.

Coming to the knee joint, I wish to explain my point of view quite clearly.

It has been considered for a long time that a bony ankylosis in a good functional position is not seriously harmful to the patient. This way of thinking agrees with the idea that a bony fixed ankylosis is always preferable to a painful, slightly movable, unsteady pseudo-arthrosis. Now that the experience of many cases has shown the possibility of creating new joints which possess excellent functional qualities, which can support any work, and which, even after many years, do not lose their power, I think that also the knee arthroplasty ought

to be accepted with greater faith and should be executed more frequently. But at the same time that I make this statement, I feel it necessary to add that knee arthroplasty should be advised only when a precise indication is recognized, and it must be executed by operators who have acquired a notable skill in the reconstruction surgery of the joints.

I have operated upon only two cases of ankylosis of the ankle joint and two of the metatarso-phalangeal joint of the big toe.

TREATMENT.

The operative treatment can be summarized under the following general rules:

1. The incision should be made in such a manner as to permit a complete exposure of the joint, without, however, injuring those parts which preside over its mobility and steadiness. As to the elbow, I have used in the great majority of cases Kocher's incision; for the hip a curved transtrochanteric incision tracing a flap with proximal base; for the knee a U shaped incision with the base downward, which surrounds the patella. For the shoulder and wrist I employ a straight incision; for the ankle joint two lateral ones.

2. In the resection, it is necessary to give to the epiphysis a shape appropriate to its function, taking off, however, enough bone to create a wide interarticular space which permits an ample movement without pressure. Between the surfaces there must be a distance of not less than an inch.

To perform the arthrolysis I make use of special curved chisels of different shapes. To smooth and model the articular surfaces I make great use of files. For the hip, I employ Murphy instruments, worked by motor.

When the epiphyses are prepared, it is necessary to remove carefully the scarred tissue in which the capsule is generally degenerated.

3. It is not necessary to insist on the utility of covering the epiphysis with a substance destined to avoid the contact between the bone surfaces. I think we may affirm with certainty that the great progress made in the field of arthroplasty must be exclusively ascribed to the interposition method. We are always free to discuss the manner of action of these substances and the utility of using one rather than the other. The results of the experiments made to clear up these questions are very discordant. While Allison's and Brook's interesting researches would seem to prove the uselessness of the interposi-

tion, the studies of Sumite, those of Neff and of Baer, and my own, prove that the substances employed greatly facilitate the formation of the neoarthrosis.

In my opinion, these substances serve: (a) to allow the sliding of the articular surfaces to take place easily, immediately and painlessly, so as to permit an early mobilization of the neoarthrosis; (b) to form a barrier to the bony formation from the epiphyseal surfaces; (c) to constitute the first trace of the articular cartilage and the first outlines of the synovial membrane, thus facilitating the formation of those mucous bursae and hygromata to which J. B. Murphy was the first to attach so much importance. I have no experience about Baer's and Cargile's membrane. I think it is not worth while to use pedunculated flaps. I have always used free aponeurotic flaps taken from the fascia lata, with which I cover the two epiphyses completely and which I fix in place with a few catgut stitches.

4. The reconstruction of the joint must be carried out according to anatomical principles and with the greatest accuracy. The stability of the new joint greatly depends upon the way in which the reconstruction has been performed. I have never used drainage.

POSTOPERATIVE TREATMENT.

The newly operated joint is immobilized in a plaster of Paris splint, in a semiflexed position. A traction is applied to the distal fragment so as to keep the surfaces distant from each other. I attach great importance to this traction which I leave in place for nearly a month, especially in the arthroplasty of the lower limb. The first movements must not begin before the tenth day, and they should be passive, executed by the patient himself by means of very simple apparatus applied to the bed. To avoid pain or fatigue to the joint, I think it indispensable that the patient should regulate the treatment himself, and not the doctor, who, at the beginning, has only the supervision of the patient.

As soon as the wounds are closed, the hot air treatment begins; in the first days it is done by means of an electric, afterwards with an alcohol, apparatus.

The hot air treatment must continue for many months. I do not attach much importance to massage in the beginning, while I consider it useful to stimulate the most important muscles by means of electricity. It is not necessary to begin the mechanical treatment before

the twentieth day. For the elbow and knee I find Bennett's old and simple apparatus very useful.

In the arthroplasty of the lower limbs, the patient does not take his first steps before the thirtieth day.

It is not worth while explaining further in regard to the postoperative treatment, because it is not possible to fix general rules. I only wish to point out that in the postoperative course of every arthroplasty there is a period which I should call *critical*, which sets in about a month after the operation, when the joint becomes somewhat painful and stiff. It is possible that during this period both the patient and surgeon have their doubts about the possibility of obtaining a good result. But in reality there is no need for anxiety. The critical period is the usual consequence of the drying up process of the joint and sometimes also, of exaggerated exercise. The hot air treatment must be suspended for some days; after this the movements may be carefully and gradually resumed. For two joints in particular, the postoperative treatment must be prolonged, namely, the temporomaxillary and the knee.

PROGNOSIS AND RESULTS.

The prognosis and results of the arthroplasty can only be judged after the lapse of a few years. Not taking into consideration the single isolated contributions which are becoming more and more numerous, there are now some very important collections of statistics, each of which consists of more than a hundred cases, which permit us to draw concrete conclusions as to the possibilities of this method of treatment and about the results to be expected from it.

Considering comprehensively the data supplied by these statistics and taking into account the opinions expressed by the most experienced surgeons, we may conclude that the prognosis of arthroplasty is improving at the same rate as the perfecting of the surgical technique and the establishing of more precise criteria on the choice of cases.

I was, myself, very reserved in my conclusions in the report I read at the International Congress of Medicine in 1913 and in that which I read before the French Society of Surgery in the same year, but now I feel that I can assert conscientiously that arthroplasty is an interference worthy of the greatest faith and destined to assure a real, functional advantage to the patient. It is obvious that a clinical experience of more than a hundred cases, extending over a period of about ten years preceded by a numerous series of experiments, permits

me to be now more decided in my statements and firmer in my convictions.

At the same time, however, I feel it my duty to add that arthroplasty is not a treatment to be lightly proposed or undertaken. It requires a vast experience in the choice of cases, a notable mastery of surgical technique, a complete knowledge of physiotherapeutic methods. It is, therefore, an orthopædic treatment in the strictest sense of the word, and it is to be hoped, for a bettering of the results, that the orthopædic surgeons will in the future make a greater use of these operations which until now have been almost entirely in the hands of general surgeons.

In judging the results of arthroplasty we must now be more exacting than we were before. The result must not be called good only in regard to the amount of movement obtained. The new articulation must possess in a just measure all the properties which render the normal joint useful, that is to say, besides the amount of movement, a good stability, a fair resistance to hard work, and painlessness. A knee which possesses only 45 degrees of movement, but is firm, strong and painless, is frequently more useful than one which can bend to the right angle, but which cannot bear the weight of the body. The same may be said of the hip.

But this is not enough. To judge of the real functional value of a new joint, it is necessary to know how it acts under the work it has to perform, because our task is not to create an articulation which only conforms to esthetical requirements, but a neoarthrosis, healthy, active, strong, capable of supporting for years the efforts and fatigue of a normal joint, and one that will be useful to the patient, whatever his profession or trade may be.

But these elements of criticism can only be collected from statistics formed from a great number of cases and concerning also patients operated upon a long time ago. I have estimated my results according to the aforesaid criteria and I have come to the following conclusions:

1. The modern methods of arthroplasty allow us to create articulations that can attain functional properties which in some cases are equal to those belonging to the normal joints; in others, the new joint can fully satisfy the most exacting wishes of the patient.

2. These articulations are able to support for many years even the work of trades which are very fatiguing. Some of my patients operated on for arthroplasty of knee and elbow have been declared capable of military service and have taken part in the war.

3. In the ankylosis of the lower limb it is possible to obtain articulations which are not only quite movable but also steady, painless and able to support the greatest fatigue. My personal experience has shown me that the knee-joint, which until a short time ago was considered at the least adapted to arthroplasty is, on the contrary, the one which can give the greatest satisfaction both to the patient and surgeon.

4. I am quite convinced that the progress which has already been made, and that which will be made, in the field of arthroplasty, is essentially due to the interposition method. For my part, I prefer to use the free flaps of fascia lata.

5. My experiments and direct examination of the reoperated joint of three of my patients have proved to me that the mechanism of formation of the neoarthrosis, obtained through the interposition of a fascia flap, is the same which was foreseen and described by J. B. Murphy.

6. The secret of the success in arthroplasty lies in the right choice of the cases, in the technical precision of the operation, and in the accuracy of the postoperative treatment.

7. As to the prognosis of each joint, taking into account only those most frequently operated, my statistics, according to successful results, give the following scale: (1) elbow; (2) knee; (3) jaw; (4) hip.

Arthroplasty is not associated with great danger to life. Out of 113 patients, I have had two deaths.

ARTHROPLASTY OF THE KNEE—REPORT OF CASES.

BY WILLIS C. CAMPBELL, M.D., MEMPHIS, TENN.

MANY predures have been devised to mobilize stiff joints, consisting of various materials being interposed, such as metals, membranes, and even an entire joint has been transplanted, but as yet no definite

measure offers a high per cent. of success, except in the elbow, wrist hip and temporo-maxillary joints, where stability is not essential and sufficient bone may be removed to insure motion. The knee joint is a different proposition and offers by far the most difficult problem, and unfortunately, is most frequently affected by acute infections with ensuing ankylosis.

In bringing this subject before you at this time, I have no method that offers a greater degree of success than has been attained. My results on the whole have not been satisfactory. Animal experiments are of little or no value, for we cannot produce the same conditions


EXHIBIT A.—Two years after arthroplasty for complete bony ankylosis, showing degree of extension.

found in an ankylosed human knee, nor can intelligent coöperation be secured, which is absolutely essential in the after treatment.

No attempt should be made to mobilize tubercular joints. Only those with ankylosis following acute infections are suitable for operation.

Pathological changes vary, depending on the nature and intensity of the infection and the resistance of the individual. Fibrous ankylosis occurs in a small proportion of cases, and may show: (1) a complete fibrous substitution with only perceptible motion; (2) irregular

scattered fibrous bands with intervening cartilage and fat: (3) irregular fibrous union with areas of destruction of the articular surfaces and hyperplastic bony outgrowths. In all types of fibrous ankylosis there may be slight motion, which is often painful. More frequently bony ankylosis occurs in which is found three distinct types: (1) complete destruction of the articular surface and adjacent bone for a short distance, with solid union of joint surfaces; (2) solid bony union of entire joint surfaces, with rearrangement of bone lamellae and canaliculization, forming a medulla which is continuous with the femur above and the tibia below, converting the two bones into one, from the hip to the ankle. This, of course, is only a phenomenon of functional adaptation and is seen in those of long duration; (3) complete bony union following infections of the shaft of the tibia and femur (osteomyelitis), with increase in bone density and loss of normal structure.

In all types of fibrous ankylosis arthroplasty may be advised, and in the first type of bony ankylosis, for only the joint surfaces are involved in the process, which may be removed, leaving healthy, spongy bone beneath. In the second type of bony ankylosis with medulla through joint, mechanically a new joint could not be reproduced, even should restoration of atrophic muscles be possible. In the third type, we cannot expect dense hypertrophic bone to form the base of a new articulation. Such material is low grade and bears the same relation to bone that scar tissue does to soft tissues.

Ankylosis may exist between the tibia and femur with patella free, or between the patella and femur with a normal tibio-femoral articulation or all parts may be united by solid bone with no line of cleavage.

Age is obviously a contra-indication. Only young adults should be considered. The procedure is advisable when malposition exists, as correction of deformity will justify the means if no motion is obtained.

The operation (for which no originality is claimed) is as follows: The common U incision is made through the skin, the outer end may be continued upward along the lateral aspect of the thigh. If the knee is extended, the quadriceps tendon will usually not allow flexion, and must be lengthened. For years I have used the usual Z. plastic method as in contractures of the Achilles, more recently the technique of Bennett has been employed. If the knee is flexed the usual incision is made through the patella tendon or this structure may be elongated. From half to an inch of bone is removed from the femur or until normal relations can be secured. The intercondylar notch is obliterated, the lower end of the femur is made to conform to the convexity of

one normal condyle. After removing the upper extremity of the tibia to spongy bone, a concave surface is made from before backward. A shoemaker's rasp is next applied to all parts to make the surface as uniform as possible. As much of the patella is removed as is consistent with tensile strength. Pedunculated, free fascia, or absorbable membrane is now interposed and the joint closed. Recently, in addition, the prepatellar bursa has been interposed by dissecting from the anterior aspect passing beneath and attaching to the opposite side. Joint line must be accurate, otherwise there will be lateral displacement. At the completion there should be considerable laxity, with hyperextension possible to forty or fifty degrees.

In those cases with bony union of the patella and femur and apparently normal knee-joint, the prepatellar bursa is employed, and the knee placed in flexion, so that the posterior surface of the patella has, in addition to the interposed bursa, the articular cartilage. The limb is placed in cast, and in some cases the Thomas splint, but no motion until the wound is healed, which requires from three to six weeks. Brisement forcé has been of no more value than any other type of stiff joint; in fact, the best results have been obtained where not employed.

Twenty-four (24) cases form the basis of this report—in ten the fascial flap transplant was used. In one, forty degrees of motion was obtained; in two, thirty degrees of motion; in one, sufficient time has rot elapsed to make final report. In the remaining six, ankylosis recurred. In nine, Baer's chromicized pig bladder was interposed. In four, the membrane, apparently of inferior quality, was extruded. In one, practically perfect motion resulted; the knee could be flexed to an acute angle with full, strong extension and no instability. In one, seventy degrees free motion; two were sequelae of osteomyelitis, with dense, low grade bone, and success could not be expected with any form of treatment. In two, free fascia lata was transplanted from the opposite thigh; both absolute failures, one infected. In three, in which the prepatellar bursa was employed, one has fifteen degrees flexion with voluntary extension, one has twenty degrees flexion with voluntary extension, one too recent to report progress. In not one of these cases can the final report be considered.

Sufficient time (one to two years) has elapsed in twenty. In four of these, faulty material (Baer's membrane of one lot) caused failure, three were in dense, low grade bone following osteomyelitis, making seven which should not be recorded as failures for reasons above stated, consequently we should only consider thirteen, nine of which obtained definite voluntary motion, in four not sufficient to be of ma-

terial value, but encouraging from the standpoint of experimental physiology. In five, satisfactory motion.

Bony ankylosis existed in twenty-four, eight in extension and sixteen with malposition. All obtained useful members in extension or slight flexion, except those which were so fortunate as to acquire active motion. In those in which ankylosis occurred, there was never active flexion and extension, but a gradual decrease in passive motion until no movement existed. In not one case with definite active motion to an appreciable arc did ankylosis recur. In all successful cases, or in those in which free motion was obtained, action of the quadriceps was in evidence at the end of six or eight weeks.

The action of interposed fascia is doubtful. More attention should be given to reconstructing a perfect mechanical joint and less to material interposed. I once had the opportunity of doing a second arthroplasty on a joint in which I had previously interposed fascia; we found ample space between the bones, but filled with dense scar tissue and the joint not movable.

In reviewing early cases, I am sure that inexperienced carpentry was a cause of failure, also the fear of producing an unstable member, and the removal of too little bone. The amount that can safely be removed has not yet been determined, but workers in this field have practically no precedent, and only by experience, which has often been disappointing, can success be obtained.

Such a report as the above is far from attractive, but at the same time, it is only by a study of such groups that we may ever approach a standard procedure which will give a high percentage of success in well selected cases.

DISCUSSION OF PAPERS BY DR PUTTI AND DR CAMPBELL.

Dr. Prince, Rochester, N. Y.: My attitude toward arthroplasty has been one of "watchful waiting." I feel that the problems of arthroplasty can be solved by relatively few men who are much interested in it and who have the facilities for doing enough cases to test out their ideas.

I believe that the pathological indications for arthroplasty are pretty well determined and that the time has come when some general application of this procedure can safely be begun. I believe that as soon as one feels that he

has the requisite technique and skill to carry out the procedure, he should then determine whether the patient has the moral right to have a movable joint. By that I mean courage; if he cannot endure suffering after the operation, the result will not be good. This, to my mind, is the most important requirement.

I think we have all had successes with jaw cases. The only hip case I have tried was a failure because the patient lacked the courage to get a good result.

I think we are all surprised at Putti's feeling that the knee joint offers so good a prognosis; certainly the results shown by Dr. Putti were better than anything I have seen before, anywhere. I believe it is largely due to his method of approach. I very much fear that the general application of this operation is going to be followed by many bitter disappointments; this is going to be because of a neglect of the indications, so well pointed out by readers, and the over-estimation of the skill and technique of the operator.

Dr. Walter Truslow, Brooklyn, N. Y.: I feel like reporting three cases of arthroplasty. In one case, I do not know the end-results. The patient was a child, who came to me with a congenital fusion between the humerus and the radius. Very curiously, when operated on, I found there was free motion between the ulna and humerus. Why it existed in a girl going on to fourteen years, I could not tell. I freed the radius from the humerus, and found that between the ulna and radius there was free motion. I put in the prepared pig's bladder and never saw the end-results. The child's mother was angry because I did not attempt to treat the webbed fingers first.

The other cases were of tubercular hip, each hip having thirty degrees of flexion. The operation was performed three years after the active symptoms had subsided. Instead of Gant's operation to improve the deformity, there was fascia lata interposed, after freeing the joint. The end-result in each case was excellent.

Dr. Edwin W. Ryerson, Chicago: I have done more than fifty arthroplasties on various joints, and it seems to me that it is a standard procedure at the present time in certain joints and that it should really be used in other joints. I have done ten or eleven knee joints, and only one was good enough for me to be at all ambitious to show it to any surgeons. The others, with one exception, were failures, and the exception has only twenty-five degrees of motion. The hip and elbow joints are the two that I have had most experience in. I have done about thirty elbows, and the majority have been very satisfactory. In the hip, I have done what I think should not be done. I have tried to carve out the head of the femur, leaving it as anatomically perfect as possible. It is not necessary to have a perfect head. I have frequently not cut out enough bone. It is remarkable to see how comfortably people get along with only a little neck sticking into the acetabulum. The most successful cases often resemble an excision of the head, with the neck forming the weight-bearing support. We should take out more bone, and should use traction afterwards. At one time, Dr. Baer advised putting the joints up in plaster casts and immobilizing them for a month or more. I did this in a dozen cases, and the result was unsatisfactory. I have used Baer's chromicized pig's bladder in the majority of cases. Though once in a while we get a bad case, most of them are satisfactory. By hardening Cargile membrane in alcohol for two weeks, it does as well as the Baer membrane, and is less irritating. By using two thicknesses, one gets a tough, transparent and pliable material which does the work as well as anything I know of. Allison's silverized fascia has not been quite so satisfactory.

Dr. Fred H. Albee, New York City: I cannot refrain from saying a word about Prof. Putti's work. I had the good fortune to visit his wonderful clinic and operate there two years ago. At that time, I also saw him do an arthroplasty of the knee, and saw several of his results. They certainly were far beyond anything that I have seen elsewhere.

In regard to the question of application and efficiency of arthroplasty, in this connection, I should like to emphasize the importance of taking up the consideration of some form of this operation for the relief of that large group of congenital dislocations of the hip that will not stay in place after bloodless or open reduction or where the femoral head cannot be got into the socket at all. The type of operation where the acetabulum is deepened by increasing its rim with bone grafts or building a new acetabulum by similar methods higher up on the ilium offers a great deal for these otherwise unfortunate cases. (See Albee's Orthopedic Surgery.) It is not so important if the acetabulum is a little above where the normal one should be, providing the hip joint is stabilized.

DR. OSGOOD: I find that I owe Dr. Starr an apology. He was down to discuss Dr. Putti's paper. I am sure you will be disappointed if you do not hear what Dr. Starr has to say.

DR. CLARENCE L. STARR, Toronto: I am sorry that you discovered the error. I was having a good time. I want to say that I enjoyed beyond measure the presentation of Professor Putti. He almost converted me. When I came here I had a feeling, fairly fixed, that the knee joint gave such good functional results after ankylosis in a good position, that it was proper to leave it alone. I came here with the intention of saying so; but after the presentation of Dr. Putti, I am not sure but that I should be willing to try it again. What we have experienced is a very distinct advance in surgery, and does great credit to him; and I think it will be an incentive to redouble our efforts.

May I emphasize what has been noted by Dr. Putti, that is, I am sure that fifteen minutes of his paper was taken up by the caution he gave as to the types of cases to be selected. I am sure you will bear with me if I bear testimony to the necessity for this caution in selecting the types of cases, and bearing in mind the indications that Professor Putti has so well put before us. Many cases will stand a lot of letting alone. I am quite convinced of it, and I am sure that Professor Putti is. There are certain groups of cases in which it might be of definite advantage to perform such an operation, and the technique presented seems to me the greatest advance so far. My feeling is that no part of our surgical work requires more judgment than to know when to immobilize a joint and when to leave it alone. Those who have had the same amount of experience that we have had, will be struck by the fact that many have not improved the limbs that were very serviceable before. I found quite a number of cases of good, serviceable elbows and shoulders especially, and some hips and knees, which, in the ordinary type of function, the board would pass as ten or fifteen per cent. disability, but which have been rendered 80 to 90 per cent., and sometimes total disability, by an enthusiastic surgeon. I have one case especially in mind, that of a laborer with an elbow in good position, who could do his work as well as before, but who was made a hopeless cripple by resection of the elbow to give him motion, which he has attained but which is painful. It is useless from his standpoint. If he had been an accountant, it might have been useful to him.

Now a word about technique, and then I am through: I have the greatest faith in the possibility of the future service of free fascial transplant. Some of my younger colleagues have been working on the question of the transplantation of tendons and the utilization of fascial grafts. I hope that Dr. Gallie will be able to present some of the work at a later session. He has demonstrated that it makes some difference whether you use a Baer membrane or an autogenous graft. It can be demonstrated that the membrane, after transplanting for some months, becomes re-vascularized and is retained as a living membrane. It makes a difference whether you have a permanent and living membrane, which will act as a future synovial membrane, or one which Dr. Baer admits will be absorbed in a certain time. Success depends on three factors: the separation of the ends of the bone; the remodeling of the bone ends to make a perfect joint; and the transplantation of the fascia lata in the double fashion.

I have to congratulate Dr. Putti on the magnificent presentation and the remarkable effect on the progress of orthopaedic surgery.

REPORT OF COMMISSION ON STABILIZING OPERATIONS UPON THE FOOT.

PART I

BY ANSEL G. COOK, M.D., HARTFORD, CONN.

At a meeting of the American Orthopedic Association, held in Toronto, in June, 1920, a Commission was appointed to investigate the best method of obtaining stability of the foot in paralytic conditions by a study of end results of at least two years' duration; these results to be collected in several large clinics for the Commission and observed by them, looking to a standardization of surgical procedures and their indications.

Dr. Ansel G. Cook of Hartford, Conn., and Dr. Walter G. Stern of Cleveland, Ohio, members of this Commission, present for your consideration the following statement of their investigations and their conclusions.

Dr. Ralph R. Fitch of Rochester, N. Y., the third member of the Commission, was unable to attend all of the clinics, did not see the patients, and consequently does not join in this report.

Dr. Cook and Dr. Stern are in perfect agreement, but as no two observers see from exactly the same angle, it was considered best that each should tell what he saw in his own words. The first part of this report, therefore, which is general in character, is by Dr. Cook, while the second part, which is more technical and detailed, is by Dr. Stern.

The only direct result of poliomyelitis is a more or less complete paralysis of various groups of muscles; sometimes even all the muscles below the knee may be completely paralyzed. Bones, joints, ligaments, blood vessels and sensory nerves are not directly affected, and any changes that may subsequently appear in their structure must be regarded as secondary and, to a certain extent, preventable complications.

The disease, after the first short acute stage, is not progressive, and one attack protects against subsequent attacks.

It has been frequently asserted that the trophic nerve centers have been so disturbed as to inhibit the growth of the limb, but this has

never been conclusively proved. It is true that a paralyzed leg or foot is always smaller than the corresponding leg or foot on the opposite side that has not been affected, and that the circulation is not as vigorous in a paralyzed limb as in a limb that is not paralyzed. This lack of proper development and feeble circulation is, however, readily explained when we consider that the paralyzed limb has not been normally used and hence has not been normally developed.

The disability of the leg and foot are therefore due to: (1) Absence of muscle power, which in time leads to disturbance of muscle balance, distortion of the bones, faulty weight bearing, strain, trauma, and the pain accompanying trauma. (2) Lack of normal development from lack of normal use.

The objects of treatment should therefore be: (1) Rest and prevention of deformity for the first six months, or until such time as the actual amount of permanent paralysis has become apparent. (2) Use to encourage growth, the prevention of deformity; also the correction of any deformity that may have developed which may interfere with the proper use of the limb.

The subject is complicated, and can be studied in many different ways. The question naturally arises, what is a stabilizing operation? The Commission decided to make a beginning by selecting the simplest case possible, a flail foot, one in which all the muscles below the knee are completely paralyzed.

In order to obtain a preliminary consensus of opinion based on the personal experience of the members of the Association, a questionnaire was sent out, in substance as follows:

"The question to be answered is, 'What is the best method of obtaining stability of the foot in paralytic conditions?' " and you are asked to judge solely from the standpoint of function and from end results at least two years after operation.

It is obvious that paralytic feet vary greatly in degree, not only in regard to the amount of paralysis present, but also in regard to the amount of functional disability. Omit from consideration all feet that, in their present condition, are more serviceable than they would be after any stabilizing operation. Omit also from consideration all feet in which the functional disability is the result of faulty balance and in which the balance may be corrected by means of tenotomy, simple tendon transplantation, osteotomy or cuneiform tarsectomy. These operations, intended to correct faulty bone or muscle balance, are not, for the purpose of this report, considered as stabilizing operations.

Consider *only* a paralytic flail foot. The foot may be flaccid or it may be distorted in various ways. If the foot is distorted, it is

assumed that you will also do whatever may be necessary to correct the distortion at the time the stabilizing operation is performed.

A stabilizing operation, therefore, is only indicated when the loss of function of the foot depends upon the instability of the joint, or joints, and when, even after any faulty balance that may be present has been corrected, the muscles are still unable to control the movements of the joint.

In judging the value of any operation, it is manifestly unfair to consider: (1) Operations done on unsuitable cases. (2) Operations unskilfully performed. (3) Cases that have not received the proper after-treatment and have suffered from neglect. (4) All infections or secondary complications which, though they may have affected the final result, were not a part of the original operation or its necessary consequence.

An ideal flail foot is one in which, although all the muscles below the knee are completely paralyzed, the patient is still able to walk without artificial aid, without pain and without a limp. Such a foot or something nearly approaching it on which no operation has been performed, is occasionally observed.

In such a foot the bone balance must be perfect, so that the body weight falls evenly and without strain. The ligaments and tendons must be strong and contracted to such a degree as to allow only the desired amount of motion and to definitely limit this motion.

In walking, the weight of the body falls first on the heel, then on the arch, and finally on the ball of the foot. The tendons and ligaments, therefore, on the front of the foot and ankle must be sufficiently contracted to prevent toe drop, and the tendon of Achilles must be sufficiently contracted to absolutely prevent dorsal flexion of the foot beyond a right angle, else there can be no efficient leverage action when the whole body weight is borne on the ball of one foot as the opposite foot swings forward in the act of walking.

A heel walker, who bears little or no weight on the ball of the foot, will always limp, because the arc of the circle or rocker which the sole of the foot forms when in the act of walking over a flat surface, is shorter on the side on which only the heel is used. This is equivalent to moving the fulcrum of the lever from two to three inches backward, thus displacing the center of gravity, shortening the time in which the foot rests on the ground, and causing an inequality in the gait.

From an analysis of some seventy answers received to the questionnaire, it was learned that while three members of the Association pre-

ferred braces to any surgical operation, at least ninety-five per cent. of the remainder preferred astragalectomy or some form of arthrodesis.

Bone grafts, wires, metal plates, silk ligatures, and even living ligatures were considered unreliable or objectionable except for temporary use in certain cases or as supplementary and rendering more firm some special form of arthrodesis.

The question, therefore, lies between astragalectomy, as advocated by Dr. Royal Whitman of New York, and some form of arthrodesis. Or, if arthrodesis is preferred to astragalectomy, whether the method advocated by the late Dr. Gwilym G. Davis of Philadelphia, should be the method of choice. In contrasting astragalectomy and the ordinary operations intended to produce arthrodesis, it would seem to the Commission that there is no practical difference as far as the risk of life to the patient is concerned.

The Commission visited clinics prepared for them in the cities of Cleveland, Chicago, Milwaukee, Boston, New York, and Philadelphia, witnessed operations, and personally examined the feet of some two hundred and fifty patients.

These were not selected cases, but were taken at random and represented a fair cross section of the work. No effort was made to influence the decision of the Commission. There were the patients, there were the records of the hospital: we could make our own examinations and draw our own conclusions.

Dr. Davis devised two operations:

First, Subastragalar Arthrodesis, in which the joint between the os calcis and the astragalus, and the joint between the astragalus and the scaphoid, is obliterated. This is done almost subcutaneously by means of a small gouge through two openings, one on the inner and one on the outer side of the foot. The foot is then moulded into the desired position, and when ankylosis takes place, if the foot is otherwise normal (and there is no lateral motion in the ankle joint), lateral motion is prevented. No bone or cartilage is removed from the wound.

This method should be contrasted with that of Dr. Edwin W. Ryerson's Triple Arthrodesis. Dr. Ryerson, through an open incision, removes the cartilage from the joint between the os calcis and the astragalus, the joint between the astragalus and the scaphoid and the joint between the os calcis and the cuboid. He also advises cutting the flexor tendons of the toes.

Both of these operations appeared to give the desired results and

not a sufficient number of cases were presented for the Commission to determine which was the operation of choice.

Dr. Davis' second operation—Transverse Horizontal Section—consists of a subastragalar arthrodesis plus a very free subcutaneous dissection of the soft structures about the ankle joint from the external and internal malleoli, and from the bones of the foot whereby the foot may be displaced backwards, or the tibia, fibula, and astragalus displaced forward. No bone or cartilage is removed from the wound. The foot is moulded into the desired position and put up either at a right angle or in moderate equinus. Later, when ankylosis has taken place, and if the bones of the foot are normal, and there is no lateral motion at the ankle joint, lateral motion is prevented. The results of the operation should be a well balanced foot, the foot displaced backwards on the tibia, fibula, and astragalus, obliteration of lateral motion, and a certain amount of definitely limited ankle motion.

In comparing this foot with any form of arthrodesis which includes the ankle joint, the Commission would have no hesitation in giving the preference to the Davis operation, done on a suitable case, because a foot with a limited amount of useful ankle motion is better than a rigid foot, and because in a paralyzed foot, unaided by muscles, the displacement of the foot backwards gives a better bone balance.

Astragalectomy, after the method of Dr. Royal Whitman of New York, consists of the removal of the astragalus through an open incision on the outer side of the foot and the displacement of the foot backwards. A new and simplified ankle joint is made by the tibia and fibula above, the os calcis below, and the scaphoid and cuboid in front. Dorsal flexion of the foot beyond a right angle is absolutely prevented by the scaphoid and cuboid striking against the front of the tibia, and lateral motion is controlled by the malleoli now resting on either side of the os calcis.

Of the two hundred and fifty cases examined by the Commission, not over twenty had relapsed to such an extent that the foot was unserviceable, and these could be easily corrected and made serviceable by a secondary operation. All of the cases of ankylosis, that is, cases in which there was no motion in the ankle joint or between the bones of the tarsus, walked well. Those in which the foot was fixed at a right angle to the leg, or in a moderate equinus, and were able to use the whole foot, walked better than those that were ankylosed in the position of calcaneus, and could only use the heel. But even these heel walkers did well, and despite a limp, got over the ground briskly and

without pain, much better than they could have possibly done with a flail or dangle foot.

Many of the cases that had had transverse horizontal section or astragalectomy were found ankylosed at the ankle joint. As ankylosis of the ankle joint is not a necessary result of either the Davis or Whitman operation, these, though painless, serviceable feet, were counted as failures, and the ankylosis was considered the result of either the selection of unsuitable cases for operation, faulty technique at the time of operation, or lack of proper after-treatment.

In none of these cases of ankylosis of the ankle joint did we find any history of infection. The principal trouble, as far as we could observe, was that the foot was not displaced sufficiently backwards, and was fixed in a position of too great equinus or of calcaneus.

Neither astragalectomy nor transverse horizontal section can be called curative in the sense that the case is definitely cured when the cast is removed and the wound healed. Unequal muscle balance will distort a growing foot and it is not always possible to predict with certainty the actual strength of a partially paralyzed muscle or transplanted tendon. Careless shoeing may also lead to disturbance of balance with consequent deformity.

All of these patients should be kept under occasional observation, if possible, until they have obtained their full growth.

Several patients on whom the operation of transverse horizontal section had been performed, and in whom the foot had been displaced well backward on the leg, were found to be capable of extreme dorsal flexion of the foot. In these the backward dislocation of the foot on the leg seemed to be sufficient, and although all the muscles below the knee were completely paralyzed and there was nothing to hold up the heel, these patients walked as well as the others.

We have used the terms, "Operations properly performed, and selection of suitable cases." For the technique of the operations of astragalectomy and transverse horizontal section, the Commission recommends the recent papers of Drs. Royal Whitman, A. Bruce Gill and DeForest P. Willard. These operations have been perfected by experience, and it is advisable to know just how these operations are being done by their authors at the present time. A still better way is to go to New York or Philadelphia and witness the operation. An astragalectomy or a transverse horizontal section is not a Whitman or a Davis operation unless it is done exactly as Dr. Whitman or Dr. Davis says it should be done.

In regard to the selection of cases, the Commission is convinced that patients having paralytic talipes calcaneus, talipes calcaneocavus and flail or dangle foot, with or without the additional deformities of varus or valgus, are suitable subjects for the operations of astragalectomy and transverse horizontal section, and that patients having active calf muscles are not suitable subjects for these operations. There is also a not uncommon class of cases which resembles equinus or cavus. These, however, have a rigid heel cord and on examination, the astragalus and os calcis are found to be in nearly normal position, and the whole drop confined to the anterior portion of the foot.

The records of the condition of the patients before operation were not always clear on this point, and the Commission arrived at no definite conclusion as to how these patients should best be treated. The Commission found no evidence to prove that either astragalectomy, arthrodesis or transverse horizontal section affected the growth of the foot, but this matter could not be definitely determined.

The Commission finds that the best time for operation is between the tenth and fourteenth year, but the atrophy from disuse is such a serious consideration in the growing child that the surgeon is often forced to operate at a much younger age. If he finds that even after tenotomies, tendon transplants or any of the minor operations have been performed, the patient is still unable to properly use his foot, even with the aid of braces, he is not only justified, but it is his duty to operate at any age.

The opinion of the patient is not a reliable guide in forming a scientific estimate of the value of an operation. With the patient, it is largely a matter of temperament. We saw several patients who were greatly pleased with very ordinary results, and others, one in particular, that were dissatisfied with what we considered very satisfactory results. There are apt to be complications which the patient does not take into consideration, such as partial paralysis of the thigh, hip, or back muscles. Of course, these patients cannot walk as well as those in which only the muscles below the knee are paralyzed.

In contrasting astragalectomy with transverse horizontal section, the Commission believes that astragalectomy done after the method of Dr. Royal Whitman of New York is the operation of choice for the following reasons:

1. It is a clean cut and the operator can see what he is doing. The surrounding tissues are not bruised or mangled, and should the wound become infected, the stitches can be easily removed and the whole cavity exposed and thoroughly drained.

2. Astragalectomy independent of the chances or process of repair, definitely and mechanically checks motion in three directions, ad and abduction and dorsal flexion, and lessens the range of plantar flexion.

3. In cases where there is lateral motion at the ankle joint, it is sometimes necessary to supplement a transverse horizontal section with an arthrodesis at the ankle joint, thus losing all motion at the ankle joint. It is urged as an objection to astragalectomy that the removal of the astragalus shortens the length of the leg. This is probably true, but how much is the leg actually shortened? The leg was too short before the operation, and it does not appear to be appreciably shorter after the operation. The shortening can be corrected by placing the foot in the position of moderate equinus and by putting a lift in the sole of the shoe. The reconstructed foot is shapely, well formed, and serviceable. Nobody unfamiliar with the operation of astragalectomy would ever suspect that the astragalus had been removed.

The Commission finds that this objection to astragalectomy is theoretical rather than practical and that it is more than counterbalanced by the advantages of the operation.

PART II.

BY WALTER G. STERN, M.D., CLEVELAND, OHIO.

Since the Association did not define in more specific terms what it meant by a "stabilizing operation," the Commission decided that for the purposes of this investigation, a stabilizing operation was one which limited the untoward motion in one or more of the ankle or tarsal joints in such a way that weight bearing and walking in the physiological position would be restored and deformity, once overcome by corrective operation, would not tend to recur. This would leave out of consideration simple tenotomies and tendon transplantations.

Over seventy-five questionnaires were answered, and practically all in such a clear and concise way that the Commission could not be in doubt as to the experience of the writer. Of these, all except one are agreed that methods designated as 1, 2, 3, (*viz.*, (1) fixation by metal plates, wires, screws and nails; (2) silk ligatures, and (3) bone grafts) are unreliable, objectionable, never indicated and are to be condemned.

Method 7. Living ligaments (after the method of Gallie, Putti,

Peckham and others) is held by the vast majority of writers to be unreliable and unsuccessful.

Only six answering the questionnaire think that living ligaments are good. The Commission was shown a considerable number of cases where the living ligaments either had stretched and pulled out, or where (when they had not done so) they did not grow with the rest of the foot, and, after a few years, a deformity in the reverse direction took place, very much like the untoward results of silk ligaments in a growing foot.

4. Arthrodesis,
5. Astragalectomy, with backward displacement of the foot, and
6. Horizontal Transverse Tarsectomy, are all considered good in their proper spheres, by almost all writers.

This left for the Commission the investigation of the relative merits of the following standard operations:

Arthrodesis,[4] either after the manner of Soule (astragulo-navicular), Ryerson "Triple Arthrodesis" (astragulo-navicular, calcaneo-cuboid, calcaneo-astragular), and the sub-astragular arthrodesis of Davis.

Astragalectomy,[5] with backward displacement of the foot. after the method of Dr. Royal Whitman, and

Horizontal Transverse Tarsectomy,[6] with backward displacement of the foot, after the method of Dr. G. G. Davis, which in the remainder of the report will be called tarsectomy. (Davis.)

For lateral instability combined with good calf muscle and with the foot more or less in equinus, there is a common consensus of opinion of all the operators whose work we have seen, that some form of arthrodesis is the operation of choice. Ryerson prefers the "triple arthrodesis," while Boston, New York and Philadelphia operators seem to favor the sub-astragalar arthrodesis of Davis. The Commission is unable to award either method of arthrodesis the palm of superiority. We did not see many results from the single arthrodesis as proposed by Dr. Soule, but it is favorably commented upon in several of the questionnaires.

The operation of arthrodesis for lateral instability with good calf muscles can be combined with fasciotomy of the plantar fascia, corrective wedge resections (especially to combat the dropping of the anterior part of the foot) and appropriate tendon transplantations, the loop operation of Whitman and the transplant of the peronei for valgus being some of the favorite operations. All operators interviewed were agreed that tenotomy of the tendo Achilles should practically

never be performed in this type of case. Astragalectomy is *not* indicated in equinus.

For the completely flail and dangle feet or for lateral instability combined with calcaneus, the vast majority preferred the Whitman astragalectomy. When done according to the Whitman method, astragalectomy, with backward displacement of the foot, should give exceedingly good results. The foot must be displaced well backwards, the calcaneus entirely overcorrected so that the patients are no longer heel walkers, and there should be some elasticity of motion between the tibia and the foot. Ankylosis is not the object of the Whitman operation. Astragalectomy can be combined with various forms of tendon transplantations or tenotomies for the correction or the avoidance of unfavorable position. Ryerson demonstrated that the toe flexors should always be tenotomized when they are as strong as, or stronger than, the muscles pulling in the opposite direction, to prevent future varus. Where there is a large amount of deformity in the forefoot, it is undoubtedly necessary to correct this before doing an astragalectomy. About this point Whitman is silent.

The common consensus of opinion is, that astragalectomy is not indcated in pes equinus or in the ordinary lateral instability, when there are *good* calf muscles left. Astragalectomy checks the untoward movements of the foot, which is that of dorsal flexion at about a right angle, and by displacing the foot backward, it restores the symmetry and power of the foot, and in successful cases, the heel and toe gait. Lateral instability is entirely overcome. Whitman also claims it is a good operation in severely paralyzed cases to permit brace wearing with comfort, and to do away with the pressure sores frequently encountered as the result of a flail ankle moving and chafing against the upright of the brace.

The operation of horizontal transverse tarsectomy with backward displacement of the foot, first advocated by Dr. G. G. Davis of Philadelphia, was devised for the overcoming of the same deformities and disabilities as the astragalectomy of Dr. Whitman, and where the foot has been displaced backward far enough, as in the astragalectomy, it has given almost equally as good results as astragalectomy. The operation is not so clean cut and essentially *surgical* as is the astragalectomy and the posterior displacement of the foot very difficult to obtain. From what was seen of the operation, it is suggested it be modified so that backward displacement be more easily attained. The very fact, however, that we had to compare the Davis operation to the Whitman

in giving it its proper place, convinces us that the horizontal transverse tarsectomy of Davis is not *the* operation of choice, as is the Whitman operation.

SUMMARY.

1. Metal plates, wires, screws, nails, are objectionable and unreliable.
2. Silk ligatures the same.
3. Bone graft the same.
4. Arthrodesis. Excellent results in lateral instability, especially where there are good calf muscles. The best results are to be found after the triple arthrodesis of Ryerson or the sub-astragalar arthrodesis of Davis. Arthrodesis of the ankle joint is rarely indicated.
5. Astragalectomy with backward displacement of the foot, when done after the method of Royal Whitman, first for calcaneus, calcaneo valgus, etc.; second, for dangle feet; third for lateral deformity, gives by far the best results. In some cases the result has been so perfect and the foot so symmetrical that it would have been difficult to tell that the foot had been operated on, had one not been able to see the scar.
6. Horizontal transverse tarsectomy, after the method of G. G. Davis, gives as a whole inferior results to the astragalectomy and is a more difficult, bloody and less surgical procedure.
7. Living ligaments, after the method of Gallie, Putti, Peckham and others, have given isolated successes, but as a general rule, have not been successful and are not held in universal esteem.

A great many of the fixation cases that were examined were done after the ordinary tendon transplantations had failed, and it would seem that the place for tendon transplantations is as an adjuvant to a "stabilizing operation."

DISCUSSION ON THE COMMISSION ON STABILIZING OPERATIONS UPON THE FOOT.

Dr. De Forest Willard, Philadelphia: After such a report as Dr. Cook and Dr. Stern have given, I think it is possible for all of us to thoroughly agree with the main features of the report. It is very difficult to lay down any absolute rules as to the procedures used in the stabilization of paralytic feet. There are so many factors that enter into it in each individual case,—the age of the patient, the amount of paralysis, not only in the leg, but in the upper leg and the opposite leg; the mental ability of the patient, and the care of the parents. All these must call for a great deal of consideration when these operations are contemplated. Unquestionably, the stabilization operations are the final operations for instability of paralytic cases. They must be thorough, and they must be permanent.

I think that I can speak for all the men of the Philadelphia clinics who have come under the influence of Dr. G. G. Davis, and I think thay my re-

marks on operations are not entirely personal, but will be backed up by the men who have been doing the work. We believe with the Committee that the operations on the soft parts are not permanent, but that those on the bony structures are, especially when combined with procedures on the soft parts. For the cases to which Dr. Stern has referred, in which there was lateral instability, but in which the anterior posterior power of the muscles was preserved, we think that Dr. Davis' sub-astragalar arthrodesis is a most justifiable operation. Lateral motion of the foot takes place normally in the sub-astragalar joints. That operation destroys these joints and thus destroys lateral motion. In some cases lateral motion of the ankle may occur. In these, we do not advise the simple sub-astragalar arthrodesis. With the arthrodesis, we still advise the transplantation of such muscles as will increase the antero-posterior motion of the foot.

As to the flail and dangle-foot types, for which Dr. Davis' operation has been compared with the Whitman operation, we feel that the latter is unquestionably a useful and important operation, but we feel, also, that transverse section with backward displacement of the foot can do the work in properly selected cases and when properly done. I feel that the Commission themselves, if they saw the cases in future years, would agree with us.

For the past three years we have felt that in our older operations the foot was not displaced backward thoroughly enough, and we think that in future they are to be displaced backward more thoroughly. We think that as we go along we shall find even better results in these cases than in the others in which the backward displacement was not emphasized as much as it is being done now.

As to the time of operation in these bony operations, the Committee, I believe, say that ten years of age is probably about the best time in the child's life. It seems to me that perhaps an earlier date could be made. I should like to have the Committee's definite opinion on that, if they will give it. We feel, in Philadelphia, that these bony arthrodeses should be done as soon after the seventh year of life as the prognosis is thoroughly established and all the power that can be obtained has been obtained.

THE TEACHING OF ORTHOPÆDIC SURGERY.

BY NATHANIEL ALLISON, M.D., ST. LOUIS.

In the world of today there seems to be an unusual desire to revalue and redefine; the feeling exists that unless we know where we are going, we are likely to arrive nowhere in particular. Our aim must be directed truly toward our objective before our action can be constructive.

The war we have passed through has brought many of our educational defects sharply to our attention. In our primary schools, in our high schools, colleges, and universities, our methods of teaching are

receiving careful and thoughtful study. The teaching of medicine as it is now taught is being carefully scrutinized. The Committee on Education of the American Medical Association has been actively engaged this last year in a survey of the manner in which medical teaching is being carried on.

President Lowell has said: "The real scholar is not a man who devotes his erudition to a small thing, or who achieves eminence in paths that no one cares to tread; not the man who knows all about the antennae of the paleozoic cockroach, or some Greek root; but the man who has the sharpened brain, who has developed that tool so that he can use it for any purpose for which, in life, he may hereafter desire to use that tool."

These words express well the trend of what I have to say on the teaching of orthopædic surgery.

Orthopædic surgery, along with other special departments of medicine and surgery, has been called upon within the past year to lay down certain rules which might act as guides and checks to those who enter the special fields of medical or surgical practice A committee of the American Medical Associaton met in Chicago last winter to discuss the minimum requirements of education and training deemed necessary for those who would call themselves orthopædic surgeons. This committee agreed unanimously upon a set of minimum requirements, especially stressing the significance of the word "minimum," and these have been set down by the American Medical Association as rules to govern the future of orthopædic surgery in so far as it affects those who will call themselves orthopædic surgeons. The minimum requirements to become an orthopædic surgeon are:

1. Standard medical school course, Class A school, four years.
2. Surgical internship at least one year.
3. Graduate course, one year as interne on service devoted entirely to orthopædic surgery.
4. Six months in allied studies, physio-therapy, shop work, and schools for cripples.

We will have then, after a total of six and one-half years of medical school and hospital work, our minimum requirement man, about to take up his life work as an orthopædic surgeon. The committee, however, recommended more work than this, namely, a three-year course leading to a graduate degree, and more desirable still, work as an assistant to a qualified orthopædic surgeon. The committee also recommended that languages other than our own should be a part of this man's accomplishments, and that he should also be versed in an-

atomy, pathology and neurology, beyond the requirements for the degree in the Class A medical school. With the minimum requirements defined and the further suggestions of the committee, it remains for us, as teachers, simply to decide what we shall teach and how we shall teach it.

In other words, from us, as orthopædic surgeons, must come the definition of our field of teaching and training for the future orthopædic surgeon, and in us must be the ability and power, as teachers, to hand on to him our knowledge and skill, and to stimulate him to constant advancement.

Dr. William H. Welch has said the following in discussing the medical curriculum: "The fundamental object of medical education is to make good doctors. Without question, that should be the underlying conception in all schemes of medical education, and unless a given course of study bears on that training, it should have no place in the medical curriculum. If training in physiology, even, cannot be shown to help to make good doctors, it is not defensible. The same can be said of pathology or any other subject in the curriculum. The ultimate aim of medical education is to make good practitioners of medicine." There can be no disagreement with this statement, I am sure, and the "good" doctor must know something of orthopædic surgery. It is obvious that in our medical school curriculum, some period of this time must be spent in the pursuit of this knowledge. The question that confronts us is how long this period must be and what it should embrace. In other words, what must the undergraduate medical student be required to know of orthopædic surgery before he is given his degree as doctor of medicine? In seeking to answer this question, I realize fully that I shall run against tradition and conventional practice.

I believe that so-called orthopædic surgery differs in none of its principles from so-called general surgery. I believe that the part cannot be greater or more important than the whole, and I further believe that surgery is more important than orthopædic surgery. In consequence, I believe that surgery should be taught the undergraduate medical student without any qualifying or hyphenated characteristics.

All too often, in my observation, the medical student gains the impression that because a certain type of lesion or disease is treated in a special clinic, this lesion or disease belongs, by some sort of divine right to a specialist in this or that specialty of medicine; and that he, the student, need concern himself little either about what is the

method of diagnosis or treatment employed, because it is of a character requiring highly specialized knowledge and skill. The student may have formed some special preference himself by the time he reaches his fourth year of medical-school work, and he is led on by the tendencies toward specialized medicine about us everywhere today. Naturally he begins to regard the "*organ* as greater than the *organism*," and to lose sight of the fact that his greatest possible achievement should be a well rounded basic knowledge of all the essentials of medicine entitling him to be a good practitioner of medicine.

The undergraduate student should be instructed in *surgery*, and that part of surgery which falls into the hands of the orthopædic surgeon should be taught by the orthopædic surgeon. The student should be guarded against the specialist point of view. He should be made to feel that the "organism is greater than the organ," and that surgery is surgery, irrespective of how many divisions are made to facilitate the proper handling of the surgical cases.

From another point of view, surgery should be taught the undergraduate as a big field of work requiring many subdivisions for purely practical reasons, but the surgery that concerns the undergraduate student is not surgical craftsmanship, but surgical diagnosis. In simple words, the undergraduate should learn primarily and fundamentally the "why" and "when" of surgical diagnosis rather than of surgical therapy. The portion of surgery known as orthopædic surgery should be placed before him, not as a department of special surgical technique, but as a part requiring skill in surgical diagnosis. As this is true of purely surgical conditions, so is it also true of medical and neurological conditions. The undergraduate student should get his medicine and surgery in the broadest possible way. He should learn to use his five senses in diagnosis and his brain in interpreting laboratory findings; his contact with clinical material should be so arranged that his knowledge of specialized medicine and surgery should come to him as medicine and surgery, not as any particular brand or department of either. To make my position clear, I would suggest that orthopædic surgery be not taught to undergraduate students as orthopædic surgery, but that the orthopædic surgeon teach them certain phases and problems of surgery. It is our custom to teach orthopædic surgery in the third and fourth years, by lectures and demonstrations. In the seventy medical schools of the United States that are reckoned "A class" schools, an investigation of the instruction given in orthopædic surgery will show that an average of about forty hours of time is taken up in various ways with the teach-

ing of orthopædic surgery. Lectures are given, demonstrations are held, and operations are witnessed, also attendance is demanded at out-patient clinics. The medical student is, as a rule, a surfeited listener at the lectures, he is mildly bored with the demonstrations, and at the operations and in the clinics, he is an "onlooker in Vienna." But above all, he gains the feeling that what he sees and hears represents the work of a group of narrow specialists, that he is not concerned with either the methods used to establish diagnosis in these cases nor with the method of treatment, unless he is to become an orthopædic surgeon; then, of course, his interest quickens

It is the custom to encourage certain students who show an interest in the subject, to elect courses in orthopædic surgery in their fourth year. A better plan would be to teach the principles of orthopædic surgery throughout the clinical years so merged into instruction in surgery that all special atmosphere is removed from the presentation. It is not our avowed purpose in any of the A class medical schools to graduate a student skilled or educated as an orthopædic surgeon or as a surgeon. He is graduated as one educated in principles and instructed in the methods of diagnosis. In fact, the science of medicine and surgery should be his by the time of graduation: the art and craft of medicine and surgery must be attained during his interne years and his early years as an assistant.

Simple adjustment in our medical school curriculum would easily accomplish an arrangement wherein all the specialties were contributors to the general educational qualifications of the student, without undue stress being laid on the specialists' point of view.

The next phase of teaching orthopædic surgery deals with the graduate student. Our typical graduate passes on from the medical school to the hospital, where he serves as an intern for one or more years. This service gives him his first real experience. After this experience, the student will desire to enter a special field of practice and may choose orthopædic surgery. What now shall be his course of instruction? The committee above referred to lays down this rule: one year in the orthopædic service in an active clinic, and six months in allied work, such as schools for crippled, work shops, physio-therapy, and what not. This minimum will give us a man well enough versed in the craft of our specialty to start out on his own for a further development. It is a scanty training for applying the label of full ability as a specialist, but it will suffice as a minimum, and not an ideal standard of attainment. An ideal equipment for such a man would be three years of work, with a university degree as its reward

(assuming that clinical graduate degrees should have academic sanction), thus insuring thoroughness and breadth by the demand for a demonstration of research ability. After that, several years as assistant to some of our ablest and best orthopædic surgeons. Sir Robert Jones says: "In my early days, under the guidance of H. O. Thomas, part of my daily routine consisted in manually unravelling advanced club-feet, aided, perhaps, by tenotomy; each case represented several months of hard work, consisting of alternate stretching and fixation. The lesson it taught was invaluable in demonstrating the effects of perseverance and patience."

Most of us can testify to similar valuable training under the guidance of some one skilled in the art and science and craft of our particular branch of surgery. Most of us also can testify to the value of daily association with our teachers. There is something intangible about this contact, there is something that bears fruit throughout one's lifetime. All realize that much that is good in us and our work came from personal contact with such men, men who had the power and ability to stimulate others to investigation.

To encourage and stimulate our future student in orthopædic surgery, a plan might well be made whereby those desiring to qualify as specialists would pass from one surgical center to another and thus receive a broadened vision of the work and a greater knowledge of the craftsmanship necessary to the proper handling of our class of clinical material. This would, perhaps, add another year to the probation period of the budding specialist, but its value is evident, for do we not, ourselves, constantly improve our methods and enrich our knowledge by visiting each other? The training necessary to an oncoming orthopædic surgeon is simply stated. First of all, he must be by training and experience, one qualified to do surgery. After several years of close application to orthopædic surgery as an assistant to some one able in this specialty, he may, if occasion demands, style himself an orthopædic surgeon and thus proclaim himself a practitioner. He will never cease to strive to improve and advance both himself and his type of surgery, if he be the right sort. He must always be a surgeon plus considerable of special qualifications. He must never be a specialist with low-grade ability as a surgeon. Much harsh criticism has come upon us from this, one of our faults in the past. Future developments must correct it.

What is orthopædic surgery? Sir Robert Jones, with his usual clearness, recently has gone thoroughly over this question and given us an answer. He says: "May I therefore venture to suggest the

group of cases which a modern orthopædic surgeon should be prepared to treat? They should consist of

"Fractures-recent, malunited and ununited.

"Congenital and acquired deformities of the extremities.

"Paralyses of the extremities.

"Diseases, derangements, and disabilities of the joints, including the spine, wry-neck, and those conditions included under the general term, 'bone-setting.' To master the intricacies of so large a section of work requires exceptional ability, and the portals of success are not open to any but the very highly trained. Some of the very distinguished general surgeons who helped us at the orthopædic centres during the war have emphasized the fact that many of the operations involved in that work were amongst the most difficult they had ever known. This is sufficiently good reason for raising the standard of education in the case of all who practice the specialty. The war has taught the orthopædic surgeon that he has to be more of a general surgeon; it has taught the general surgeon that he should be more of an orthopædist."

Our own experience in the war demonstrated the truth of the above remarks of Sir Robert Jones. He adds this bit of wisdom later, in the same address: "A great defect in our large general hospitals is the system whereby the surgeon is expected to treat equally well cases in regard to which he is an acknowledged master, and cases which do not interest him in the least. Once a surgeon is convinced by demonstration of his inability to give the best to the patient, he would no longer care to invite comparison."

The answer to the question, "What is orthopædic surgery?" has at least two aspects. The first is the division of clinical material, and the second is the relationship of orthopædic surgery to general surgery, to medicine, and the other specialties. Perhaps a sharp division of clinical material can never be established, perhaps there is no just reason for having it established. Perhaps, in certain things, old custom and long familiarity will settle the proper place in the subdivisions of medicine and surgery for a certain disease or lesion to find its treatment. It is the border-land material that interests us most, and it is here that most can be accomplished by mutual study and co-operation with other departments of medicine and surgery. Consider for a moment the value to us of the association with the skilled neurologist and physician, review the numerous problems that joint effort has helped to solve glance back at the advances that have been made through studying clinical problems with the urologist, the

laryngologist, and the oral surgeon. Elasticity, interchange of ideas, and mutual, combined effort in study are the cardinal virtues to be striven for in the inter-relationship of the various clinical divisions of medicine as a whole. Our little wars with the so-called general surgeon come from a misunderstanding of terms, and an insistence upon rigid observance of what are regarded as rights and privileges. There is a certain type of so-called general surgeon who desires to operate only. His interest in surgery is largely from the standpoint of operative technic. Such a one will manifest his interest in the operative side of the diseases that affect the bones and joints, but this interest will fail during the long period of treatment necessary in these conditions. He is glad enough after operating, to turn over the case and responsibility to, perhaps, an orthopædic surgeon. Against this attitude in surgery there should be vigorous protest. The rule in surgery should be that unless a surgeon is willing and skilful enough to care for all the phases of diagnosis and treatment that arise in the individual he assumes the responsibility of treating, then he should assume none of the responsibility, but should advise the patient to seek surgical aid from a surgeon who is able to direct the treatment of the condition from start to finish. The material seen in the practice of any orthopædic surgeon will show a certain percentage of individuals afflicted, not by disease or injury alone, but also by improper diagnosis and treatment, and especially improper sequence of treatment. The fact that ultimate function should be the aim of surgical treatment should not be proclaimed a special attribute of orthopædic surgery. This principle should pervade all surgery. Unless a surgeon has this point of view, he becomes simply an "operator." We must teach our students that the operative side of surgery is comparatively small, that it is necessary to be able to operate well in order to deserve the name of surgeon, but that the ability to operate well alone does not qualify a man as a surgeon. I have often wondered whether it would not be better to regard our specialty as an integral part of surgery, perhaps dealing with the diseases and injuries, malformations and defects, muscular, circulatory, and nervous, of the extremities and spinal column; having as its guiding principle the establishment of function. Let us not have a narrow point of view, and let us have no limiting boundaries. "There is no operation which is essentially orthopædic, there is no splint, simple or complex, which bears the peculiar mark of the orthopædic surgeon." The important thing is that we should train ourselves and our students so that our minds and theirs shall be alive to the ultimate restoration of function. It should be

our mission to introduce this point of view into the practice of surgery and medicine in all departments. "What is orthopædic surgery?" It is simply this,—the surgery of the extremities and spinal column, which has the reëstablishment of function as its guiding principle.

Teaching methods must concern us, as we are of necessity the teachers of the future surgeons who will engage in orthopædic surgery.

There are three commonly used methods of teaching—the didactic lecture, the demonstration, and the clinical conference, either in the lecture room, wards, or the out-patient department. The teaching of orthopædic surgery is carried out in our "A class" schools by these methods.

First, the lecture as a means of instruction. Do not most of us remember much tiresome expenditure of effort, both by lecturer and class, in the pursuit of knowledge by this method? Dr. W. T. Councilman makes this agreeable comment on the lecture as a means of teaching. He says: "Unless the student can gain in the lecture mental recreation and stimulation, the lecture had best be left out, were it not for the aspects which are not usually regarded as among its assets. One is the power of inducing gentle, refreshing, noiseless sleep in the audience, and the other is the educational value of the lecture to the lecturer. To one who is a poor sleeper, there comes a great satisfaction to see sleep descend upon an audience. The lecturer experiences an exhilaration of the demonstration of the possession of a power which makes him akin to God, 'who giveth his beloved sleep.' "

The didactic lecture is less used each year in all our methods of education. Perhaps the reaction against it will undergo modification and it will come back, but one feels that it will never again occupy the place it once did in our teaching methods.

Secondly, in the teaching of orthopædic surgery and kindred branches of knowledge, the demonstration will always have a place, but it should be a demonstration of some principle rather than a demonstration of skill on the demonstrator's part. It should have for its object, "the full recognition of the individuality of disease, carrying with it the necessity of detailed investigation of every case." "Diseases with appropriate remedies cannot be tagged and placed in pigeon-holes." We should order our teaching so that the result of it will be to stimulate the student to seek knowledge by scientific methods. The student and teacher should work together in this pursuit. Dr. C. S. Minot expressed his view on this subject as follows: "The very best that can be said of a lecture or a book is that it describes well the knowledge which some one possesses. There is no knowledge

in books. A book or a lecture can assist to acquire knowledge with lessened loss of time. Knowledge lives in the laboratory; when it is dead, we bury it decently in a book. . . . A lecture is a spoken book." We must teach our specialty in the clinical laboratory. We must teach it as a science and a craft.

We must, however, stimulate the student to look into books and read lectures "on his own." Surely we must know the background of our special field in surgery. Surely we must keep alive an interest in the investigation of others. To accomplish this, we have a very serviceable instrument to our hands in the review clubs and journal clubs, whose activities are controlled by the students themselves. A good example is that excellent publication produced by Robert Osgood and his associates, called "Progress in Orthopædic Surgery."

It would be well to insist that all students who are seeking qualification as orthopædic surgeons should possess a knowledge of the pathology of bone as tissue and as a substance. The work of Ollier should be the common knowledge of all orthopædic surgeons. Such reading will stimulate the investigative imagination of some, and scientific investigation in the special pathology of the bones and joints is needed. Our prospective orthopædic surgeon should be a man well trained in the laboratory methods of surgical pathology; he should know as part of his common stock of knowledge the literature of the pathology of bones and joints. He should be entirely familiar with the microscopic pictures presented by normal and diseased bone, and by bone undergoing repair and regeneration, as well as disintegration.

Thirdly, the clinical conference. As a means of stimulation, both to the teacher and to the student, the properly conducted clinical conference is of great value. The student is put upon his own mettle, he has an opportunity to work up the case assigned to him so that not only the other students, but also the teacher, may learn. His omissions are as instructive as are his observations. This method, to be fully effective, must be carried on with frankness and informality, and the student must be encouraged to set out for criticism his own point of view, and to defend his methods of examination and the deductions made therefrom. Above all else this method tends to develop proper thinking.

We must realize the economic side of a long term of years spent in unremunerative preparation. And we must face the practical questions before us. There are in this country seventy Class A medical schools. If each medical school in Class A started, each year, two men on the road leading to qualification as orthopædic surgeons, the annual output

would be 140 men. This helps to visualize the necessity for training specialists. It suggests that the general surgeons must care for much of the work. It is our duty to turn out of our "Class A" medical schools, and better hospitals, men who can meet the demand made for what is known as orthopaedic surgery. We, as orthopaedic surgeons, are responsible for this. We must not only educate and train well a few men, but we must educate and train all medical men in the diagnosis and principles of treatment of surgery of the extremities and spinal column. Having as our object the reëstablishment of function to the diseased or injured part, we must first instruct so that the importance of the whole is not lost sight of in the consideration of details. On details, however, we must insist in our later training. For the orthopaedic surgeon must be careful, exceedingly painstaking, deft, and skilled in examination and craftsmanship.

"Of all the sciences, the slowest to progress is the science of education." The thing most needed is the realization on the part of the teacher that he himself should be a student. Also that true education has for its aim the development of the student, and the "sharpened brain." In the teaching of orthopaedic surgery there would be no hope for the future unless the teachers of this part of surgery felt the urge to sharpen the brains of their students for further progress.

It is in ourselves, in our attitude toward our work, that lies the future of training and teaching better orthopaedic surgery and better surgeons to do the work.

DISCUSSION OF DR. ALLISON'S PAPER.

Dr. Robert W. Lovett, Boston: *Mr. President:* I will take up only a minute, because I am so thoroughly in accord with what Dr. Allison said and the way he said it that I shall not make any additions or changes. So long as we remember that we are teaching surgery, we are all right. It think that one thing that we can do which should help is to teach our branch better than they teach other branches of surgery, and in a way to make more impression on the student. There is no use in teaching text-book material for the student can read that, and we could save the time. What is the use of going to lectures and exercises when we could stay at home and read what these contain in less time? Our teaching should deal with things outside the books and should be extra-textbook teaching.

If we regard it as a specialty, it has not one disease to deal with or one organ. Every other specialty deals with one system or organ, or one disease; ours deals with every organ and many diseases.

We have to remember, as Dr. Allison says, that we are only a department of general surgery. I should be glad to have orthopaedic surgery taught in closer connection with general surgery. That cannot always be arranged, but in this community it could be done.

The name of orthopaedic surgery is not descriptive, and probably in time we can get something better. We should remember that we are teaching only a branch of surgery and, if we wish to make our branch more prominent and effective, we should teach it and practice it better than our colleagues in the other branches.

DR. CHARLES F. PAINTER, Boston: I am heartily in favor of everything that Dr. Allison has said, so I only wish to emphasize what I believe to be a paramount issue in all medical school teaching. There is no question but that we are becoming too highly specialized in the schools. Those who have had any experience with the administration of medical schools problems must realize the pressure which is all the time being brought by the special departments for more time for their particular specialty and this time can only be procured at the expense of the two great departments in every medical school, the departments of medicine and surgery. The school must first of all graduate well grounded practitioners and, after that they may devote any remaining time to perfecting such graduates as choose to specialize.

When it comes to this preparation for a specialty, that is a different matter. I believe that this can be solved by the controlling powers in our universities. They must help out the medical schools in limiting specialization and improving the quality of the product. I think this will be most satisfactorily accomplished by giving a degree of an academic character, which shall be equivalent to the Master of Arts degree, to supplement the degree of Doctor of Medicine. Just what the composition of the course shall be that will lead up to this degree, must have considerable thought put upon it; but I believe that, with the medical school curriculum properly pruned, there will be time provided for better grounding in the fundamentals of medicine and surgery, thus ensuring a better foundation upon which the special courses may be built. I think that two years or two years and a half would probably be enough, after such a preparation, to devote to any specialty. I am quite sure that when the time comes, that something of this sort can be done, the numbers of qualified specialists will be much more adequately proportioned to the needs of the community than at present. We shall not only serve the community better, but turn out men who will serve the interests of the specialty better than we are doing now.

I was particularly glad to hear such an expression as Dr. Allison's this afternoon come from our own Association. I have not heard much said about it outside and I hope that we can be pioneers in convincing medical schools that this is the best way of administering the affairs of the medical school in respect to the teaching of the special branches of medicine and surgery. I know that it would be for the best interests of the medical schools themselves, as well as for the public, if the departments of surgery should be uniformly organized so as to have the Professor of Surgery chief of all the surgical specialties, having the heads of the special departments under him with the title of Assistant Professor in the various sub-departments.

LOW GRADE INFECTIONS OF THE VERTEBRAL BODIES, PROBABLY STAPHYLOCOCCAL.

BY F. C. KIDNER, DETROIT.

THE industrial problem of the painful, lame back is a serious one and seems to become more serious day by day. Men incapacitated because of a painful back, flood our clinics and compensation boards,

Causes of the pain are many and we must admit, often poorly understood. Muscule-insufficienv, ligament strain, bad posture, sacroiliac and lumbosacral sprain, arthritis of one or more joints, compression fractures,, minor displacements, tuberculosis, syphilis, osteomyelitis, and many others are principal or contributing causes. The exact importance of any one or combination of these in the causation of pain, is difficult to determine. We are forced to admit, too, that treatment is tedious and unsatisfactory. Much of it is empirical and based on anything but an accurate physiological or pathological foundation. Much study must still be put on diagnosis, classification, and treatment, if we are to satisfy the demands of the community and confound our friends, the osteopaths, chiropractors and all the other groups of pseudo-scientific healers.

This being the situation as the writer sees it, it becomes worth while to report and discuss any groups of cases which present clear-cut entities and in which a certain form of treatment gives consistently satisfactory results.

The writer therefore presents the following three cases in the belief that they are all examples of a low-grade infection of the vertebral bodies, by pus-forming organisms, and that they have been cured by bone-bridging, in two cases by means of bone-transplants, and in one by nature's own method of new bone-formation.

Case 1. C. E., 33 years old, white, male, engineer and draughtsman. Occupation sedentary, but has always been normally active in sports, etc. Past health always excellent, family history good; never had gonorrhea, syphilis, typhoid or tuberculosis. In November, 1917, without history of injury sufficiently important to be remembered clearly, began to have pain in right lower back, loin and hip. Not incapacitated but very uncomfortable. Thinks he had had a little fever. Treated by osteopath till July, 1918, when he was forced to go to bed because of increase of pain, which he attributes to forcible manipulations. Pain at that time, in back, both hips and down both legs. Relieved but still present in bed. At this time left leg was flexed and weak for several months. In bed three weeks, then at desk job in spite of pain, till October, 1919. Then in bed until Christmas with adhesive strapping. In January, 1919, not better. X-ray taken, was said by an orthopædic surgeon to show displacement of right sacroiliac joint. Went to hospital where he was manipulated under anaesthetic and put into plaster jacket which he wore two months and then had brace. Enough relief of pain to allow him to go back to desk job, which he stuck at irregularly until February, 1920. Always in pain, sometimes so

severe as to lay him up for days or even weeks. In February, 1920, he felt discouraged with his surgeon and went to a competent x-ray man who examined the whole lumbar spine. This plate revealed a peculiar punched-out loss of substance in the lower right surface of the third lumbar vertebra with some thinning of the intervertebral disk, and a peculiar horn-like growth of new bone, originating from the edge of the diseased portion of bone and growing toward the side of the body of the next lower vertebra, in an apparent attempt to form a truss or bone-graft. He was referred to the writer and immediately consented to an operation for transplanting a piece of the tibia into the spines. He had no visible deformity or crushing of the vertebral body as would have been expected in tuberculosis. Operation was done in March, 1920, three spines on either side of the lesion being included in a heavy tibial graft. Convalescence uneventful, except for a low-grade infection which caused the extrusion of small bits of the graft for several months, but which did not interfere with its strength. Kept in bed eight weeks, then gradually up with a spring back-brace. Pain which began to lessen a few days after the operation, had entirely disappeared at the end of three months, when he went back to work. Now a year and four months after the operation, he is absolutely free from pain and eager for more violent physical activity than it seems best to allow him. The bone cavity is apparently filling in and the new bone-overgrowth seems to have completed its bridge. Laboratory examinations in hospital before operation showed nothing abnormal except a slight increase of the polymorpho-nuclear cell percentage. Widal, Wassermann and Von Pirquet negative. Never had pervertebral abscess.

Case 2. E. McC., 32 years old, white, male, seen first in December, 1919. Mechanic, used to heavy lifting. In 1913 while in the army, hurt his back while scrapping with other men. Bothered him several weeks. No history of typhoid or syphilis. Gonorrhea eight years ago which has not troubled him since. Had tonsils removed five years ago because of sore throats. Has always been a happy-go-lucky fellow who took no care of himself. In July, 1918, while sitting reading, developed a pain in his lower back. Next morning unable to get out of bed because his back was stiff. Body was drawn over to the right with drawing up of the left leg. In bed two months. No rise in temperature but rapid pulse. Then got up but had pain in back, both hips and both legs for six or seven months. Did not work. In August, 1919, had abscess opened in back which continued to discharge. In October, 1919, went to Ann Arbor

where he was thoroughly examined and was told he had early tuberculosis of the spine. Wassermann at that time, negative. He was put into a plaster jacket which he removed the next day on getting home. Then went to a science healer without relief. In December, 1919, went to a competent surgeon, in Detroit, who had further x-rays made and told him that he had tuberculosis of the fourth lumbar vertebra. Referred to the writer. Examination showed marked spasm and limitation of motion of the whole lumbar spine. Just to the left of the spinous process of the fourth lumbar vertebra was a sinus resembling the ordinary tubercular one. The x-ray showed an irregular, punched out area of necrosis in the upper left side of the fourth lumbar extending to the cartilage, which was thin. There was less new bone-overgrowth than in Case one. In spite of this new bone, it was believed that this was a tubercular process and that the sinus came from an abscess originating in the vertebral body, although barium injection of the sinus showed no connection. On the assumption that we were dealing with tuberculosis, an attempt was made to side-track the sinus to the outer side of the erector spinae, so that a bone graft could be done safely. The sinus was found to lead to a collection of pus and bone fragments, lying in the neighborhood of the base of the articular process on the left. Even this was thought to come from the lesion in the body. Pathological examination of the material failed to reveal tuberculosis. Unfortunately cultures were lost. After this operation, both sinuses remained open, discharging pus and bits of bone in small quantity. There was a slight temperature and blood counts, before and after operation, showed increased polymorphonuclear cells. The patient was gotten up with a brace and loafed about, suffering some pain. He refused to carry out any treatment for his tubercular lesion and, indeed, acquired an active Neisser infection with epididymitis in the spring of 1920. A series of Wassermann tests at several different hospitals during 1920 were sometimes positive and sometimes negative, and he received some half-hearted anti-syphilitic treatment as he drifted from place to place. After losing sight of him for eight months, the writer recently saw him again, to find, to his amazement, that the man was perfectly well and working. Sinus closed permanently two months ago. He was wearing no support and had no pain. His Wassermann is consistently negative. His spine is rigid in the upper lumbar region and his x-ray shows a complete bridge of bone across the lesion in the second lumbar body to the third lumbar body. This lesion seems to be filling in and there

is a second healing lesion in the spinous process of the fourth lumbar, apparently the source of the old sinus.

CASE 3. S. N., 29 years old, male, white, laborer. While playing ball in May, 1920, fell across a base and hurt his back. Unable to walk for five days. X-ray said to be negative. ncapacitated all summer by back pain and thinks he had some fever. Pain in whole lumbar region and both hips. X-ray in September, 1920, again said to be negative. When first seen by writer in January, 1921, he had all the signs of tuberculosis of the second lumbar, except for the fact that the x-ray again showed the peculiar punched-out lesion of the lower surface of the vertebra, with thinning of the disk and the horn-like overgrowth of new bone approaching the next vertebra, and an increased percentage of polymorphonuclear cells. No history of typhoid, no syphilis or gonorrhea. In February, 1921, he had a bone transplant, as did Case 1. He has had a normal convalescence with gradual disappearance of pain, and is now well enough to be about freely, wearing a light brace. His x-ray shows further new bone formation and an arrest of the process in the vertebra.

In these three cases, typhoid and syphilis can be ruled out by the history. Gonococcus entered into only one, and then after the appearance of the lesion. Tuberculosis is highly improbable, because of the new bone production, the blood count, the tendency of the lesion to be self-limited, the absence of prevertebral abscess, and prompt cure with good degrees of fixation.

The writer believes that the localization of the disease in a small area of bone, the slight tendency to collapse, the new bone formation, the tendency to get well promptly, and the double infection in one case, justify the assumption that these cases are caused by a staphylococcus of low vitality, closely analogous to that in Legg-Perthes disease; that they represent a considerable group of cases; that they should be recognized early and differentiated from tuberculosis; that they should be treated by early operative fixation, as we are treating painful compression fractures.

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AVULSION OR FRACTURE OF THE LESSER TROCHANTER.

BY C. F. EIKENBARY, M.D., F.A.C.S., SPOKANE, WASHINGTON.

FRACTURE of the lesser trochanter, either from muscular action, or from direct violence, is said to be a very rare condition. Keene mentions that such an accident has been reported, and Kelly and Roberts say that a few cases have been reported, usually in connection with intertrochanteric fractures. The writer has had three cases come under his care, all of them due to muscular action, which leads him to think that the accident may not be as rare as is generally thought. In none of the three were there any other fractures, nor was the fracture of the trochanter complete in any one case. From a study of the Roentgen plates, the conclusion is reached that the fracture or avulsion (which seems a better term) may be complete, only a part of the trochanter may be torn off, or the muscular attachment of the ilio-psoas may be torn loose. In any event the symptoms would be the same. Figure 1 shows the slight proliferation near the tip of the lesser trochanter, indicating that only the muscular fibers were torn loose, the resulting proliferation being due to the torn

periosteum. Figure 2 shows a more extensive proliferation, indicating that probably more of the trochanter was torn off, and that there was a greater injury to the periosteum. This picture was taken about two months after the injury, whereas the radiograph for Figure 1

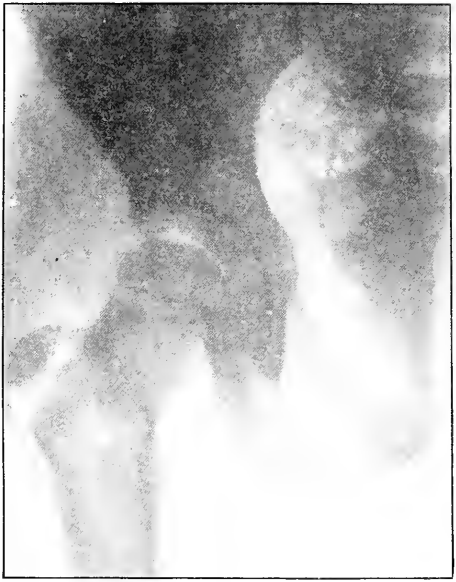

FIG. 1.

was taken within three weeks of the injury, which might account for the difference in the amount of new bone formed. Fig. 3 shows a definite separation of the outer portion of the trochanter.

Symptoms:

Two symptoms have been present in all three cases, namely, a tendency toward flexion, and pain upon pressure over the region of the lesser trochanter. In one case there was some resistance to both internal and external rotation; one case showed a slight resistance to both abduction and adduction; in all three there was resistance

to extreme extension; all walked with a marked limp, and with a decided lordosis.

Treatment:

Two of the cases had been treated by osteopaths before coming under our care, and had been given the usual diagnosis of dislocation of the hip, and the third case had had no treatment for nearly three weeks following the injury. Therefore, in each instance healing was fairly complete before coming under our care, so that the most

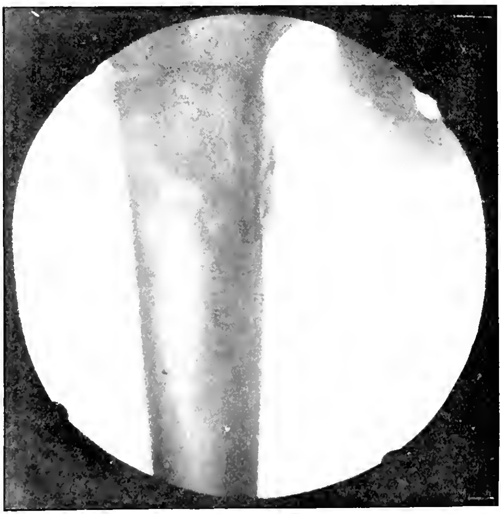

Fig. 2.

expedient thing was to correct the deformity and limp. Accordingly, in each instance, the child was anesthetized, the deformity corrected by placing the limb in full extension, and a plaster cast applied. The cast was worn for six weeks and was followed by complete recovery in each instance. Considering that the ilio-psoas muscle is the offending structure, it would seem that the logical procedure in the recent cases would be to immobilize the hip in flexion. This would probably mean that an anesthetic would later on have to be

administered, and the flexion deformity corrected. The writer doubts whether, from a purely practical standpoint, it makes any difference whether the hip is put up in flexion or extension, except in the cases where the avulsion is complete.

Fig. 3.

Mechanism of the Injury.

The center of ossification of the lesser trochanter begins to develop about the fourteenth year, and shortly afterwards fuses with the shaft. To this region is attached a very powerful muscle, the ilio-psoas, which is chiefly concerned with flexion. Considering the fact that up to the fourteenth year or later, the trochanter is very loosely attached to the shaft, it is easy to see that a powerful exertion of the ilio-psoas could easily tear off either the trochanter as a whole, or any

part of the same. In this respect the condition seems to the writer to be analogous of the so-called Osgood-Schlatter's Disease. The writer's cases were respectively seven, eleven and thirteen years of age. In each instance there had been a severe injury. The oldest case had been in an auto wreck, and had sustained a severe fall. The case aged 12 had been thrown from a wagon, and by a severe exertion saved himself from being run over. The case aged 7 had fallen astride of a cellar door. In each instance the traumatism was certainly sufficient to produce the described lesion.

Since writing before, Dr. McClure of Portland, Oregon, has very kindly loaned me a radiograph of the case of "Avulsion of the Lesser Trochanter," which is included in this report.

DYSOSTOSIS CLEIDO-CRANIALIS.*

BY PROFESSOR MURK JANSEN, LEYDEN, HOLLAND.

THE two symptoms to which dysostosis cleido cranialis owes its name are the enlargement of the large fontanel and the pseudo-arthrosis or absence of parts (or the whole) of the collarbones. Besides these two symptoms, we have found two others in all cases of dysostosis we have been able to examine, *i.e.*, in seven cases belonging to three families not mutually related:

1. Shortening of the toes. The middle phalanges are too short and

* Read at a meeting of the British Orthopædic Association, June 4th, 1920.

the terminal phalanges lack their widened ends, which look as though they had been nibbled off.

2. Bilateral flattening of the chest.

The flattening of the chest is a mechanical malformation, as are the well-known angular curve in the base of the skull and the displacement of the face, which seems to be pushed onto the base of the skull.

The shortening of the toes is a phenomenon of growth-stunting, as is the enlargement of the large fontanel and the well-known shortening of the extremities.

Both the mechanical malformations and the symptoms of growth-stunting may be explained by assuming that the foetus has been infolded both in its length axis and its transverse axis in the eighth week of foetal life. Direct amnion pressure forces the forehead of the foetus against its chest and the shoulders are pushed forward. The frontal bones, as well as the other bones of the cranial roof, are at that time changing their scleroblastemetous consistency into bone, and thus developing rapidly. Our law of the vulnerability of fast-growing cell groups explains why these very parts are affected by retardation of growth. Enhanced indirect or hydrostatic pressure compresses the middle and terminal phalanges of the toes, which are the only skeletal parts that are still scleroblastematous and at that moment grow rapidly, changing into cartilage.

It is understood that compression of the flexible parts means arrest of blood supply and famine to them. Now, famine to growing parts means death if continued sufficiently long. It means dwarfing of the parts if it is less intense. We thus meet with two principles:

1. Arrest of blood supply may produce dwarf growth (or death).

2. The dwarf growth is proportional to the rapidity of growth. (Law of the vulnerability of fast growing cell groups.)

By applying these principles in the various stages of development of the foetus, we come to the conclusion that smallness of the amnion may produce: anencephaly in the 2nd or 3rd week; cyclopia (from synotia to cebocephaly) in the 3rd or 4th week; achondroplasia in the 5th or 6th week; mongoloid idiocy in the 7th week (v.d. Scheer); dysostosis cleido-cranialis in the 8th week (v.d. Scheer); congenital dislocation of the hip-joint and clubfoot after the 8th week.

FEEBLENESS OF GROWTH.

By comparing the growth of children of the same parents with regard to injurious agents that have affected them, the symptoms of feebleness of growth may be discovered.

They are subject to five fundamental rules:

1. Feebleness of growth may be produced by any nocive agent affecting the child either before or after birth.

2. Feebleness of growth is proportional to the intensity of the nocive agent.

3. Feebleness of growth is proportional to the rapidity of growth both of the parts and of the individual. (Law of the vulnerability of fast growing cell groups.)

4. Feebleness of growth is characterized by enhanced fatigability of the parts.

5. In feebleness of growth the three stages of bone growth (cell division enlargement and differentiation) are affected in inverse order.

By applying these rules in the comparison of children of the same parents, it is found that pedatrophy, athrepsy, "rachitis," exaggerated height of persons outgrowing their strength constitute a descending series of phenomena of feebleness of growth.

NEWS NOTES.

The next meeting of the Central States Orthopædic Club will be held on November eleventh and twelfth, in Kansas City, Mo., and Iowa City, Iowa.

Current Orthopaedic Literature

ANTERIOR TORSION OF UPPER END OF FEMUR IN CONGENITAL DISLOCATION OF THE HIP. ITS CORRECTION. Froelich. *Revue d'Orthopedie*, May, 1921, p. 213.

If a normal human femur is laid on a table posterior face down, the two condyles and the great trochanter will rest on the table, but the neck and head will point upward at an angle of about 15 degrees from the flat surface. In congenital dislocation this anterior torsion of the upper part of the femur may be as much as 90 degrees; that is, the head and neck point straight forward. In such a case, to hold the head in the acetabulum after reduction, it is necessary to rotate the femur until the knee points directly inward. Then when the leg is allowed to go back to normal position the dislocation usually recurs.

This cause of failure is well known and it is generally thought that osteotomy of the femoral shaft is indicated, but this operation can be avoided by a very simple procedure. The dislocation is reduced and the leg placed in extreme internal rotation as usual. Then after a few months, the cast is removed up to a few centimeters above the knee and a supra condylar fracture of the femur is produced without osteotomy. The knee is then rotated to its normal position and held there for a month longer until the fracture is healed.

The femur in children is said to break very easily at this point, especially after being in a cast several months. The extreme anterior rotation which necessitates this procedure is rather rare; only ten out of a thousand cases occurred in the author's clinic.—*William Arthur Clark, Pasadena.*

TUBERCULOSIS OF THE HIP; STATISTICAL STUDY ON 506 CASES TREATED AT THE ISTITUTO RIZZOLI. S. Vacchelli. *Chirurgia degli Organi di Movimento*, April, 1921.

Between 1899 and 1919 there were treated in the Instituto Rizzoli, 2790 cases of tuberculous joint and bone disease, among which were 750 cases of hip disease. This gives tuberculosis of the hip second place, (26.9%), while tuberculous spondylitis holds first place (45.5%) and tuberculous knee disease third (14.4%). Of these 750 cases, 506 are included in the author's statistics.

Heredity. One hundred and fifty cases, or 29.6%, gave hereditary data in regard to tuberculosis. Trauma was mentioned in 81 cases, or 16%. Of preceding or concomitant tuberculous disease, pleurisy was recorded in 46 cases, scrophulosis in 24, periostitis and ostitis in 23, and spondylitis in 16 cases. Of preceding hip joint lesions of non-tuberculous character, there were four cases of

congenital dislocation of the affected hip and one case of pathological dislocation following osteomyelitis.

Pain. In four-fifths of the cases there was noted a sudden and violent appearance of pain, with attacks of acute pain even in position of rest associated with rapidly developing flexion contracture of the thigh.

Limp. Limping was found to be a constant symptom, which in some cases preceded any other symptom of hip disease.

Rigidity. Rigidity was likewise a constant symptom, associated with pain and observed in various degrees, from simple reflex tension of the muscles to absolute contracture with complete fixation.

Position. Normal position was found in 123 cases. The most common pathological position was that of adduction flexion and inward rotation, (105 cases), next that of abduction flexion and outward rotation (55 cases). In all cases of bilateral hip disease (7), the position was one of flexion, abduction, and outward rotation on one side, and of flexion, abduction, and inward rotation on the other side. It is generally assumed that in hip disease there are two periods in regard to the pathological position: first that of flexion, abduction and outward rotation, and second, flexion, adduction, and inward rotation. While this is true for a majority of cases, there is, however, a not inconsiderable number which differ from this typical course. The single components of position may act independently, as it were, and produce atypical combinations of position. The reason for such deviation from the usual type may be seen in the different localizations of the primary tuberculous focus in the hip: extra-articular, in the head, in the acetabulum, or synovial.

Measurements. In 184 cases, or 36.3%, there was shortening; only in 2 cases a lengthening of the affected side. Twenty-eight cases showed pathological dislocation of the head, among which were several cases of central (intrapelvic) dislocation.

Abscess. Abscesses were found in 205 cases or 40.5%. They were distributed as follows: anterior 75 or 14.7%, external 61 or 12%, internal 32 or 6.3%, gluteal 16 or 3.1%, pelvis 5 or 0.9%.

Sinuses. Among the 205 cases with abscesses, 86 had formed sinuses, situated internally, anteriorly, externally, posteriorly, or in the pelvis. Of these 86 sinus cases, 16 followed operative intervention, either resection of the femoral head or removal of the tuberculous focus.

X-ray. Three hundred and seventy four cases were radiographed. According to the seat of the disease, the author distinguishes the following groups:

1. Diffuse lesions with atrophy, 52 cases. The atrophy involves head and acetabulum. No distinct tuberculous foci are seen.

2. Isolated foci, 122 cases.

(a) In the head of the femur, 60 cases. Situated in the upper or lower pole, they may or may not communicate with the joint cavity.

(b) Foci of the neck, in the upper, lower or central part of the latter, 24 cases.

(c) Foci of the acetabulum. From simple erosion to extensive destruction causing enlargement of the socket and upward migration of the head, 30 cases.

(d) Trochanteric foci, 8 cases.

3. Diffuse foci of head and socket, 220 cases. The most frequent type.

(a) With total or partial destruction of the head, 21 cases. In partial destruction there is often left, from the lower half, a bridge of bone, lodged in the acetabulum and preventing the total dislocation of the head.

(b) Dislocation of the epiphysis, 23 cases. These cases are almost always accompanied by grave lesions both of the head and the socket.

(c) Intra-articular pseudarthrosis, 4 cases. In a small number of cases the severe lesion of the head and neck causes the total separation of the head. It is found free in the acetabulum, occupying its normal place. The rest of the epiphysis, and the neck, however, wanders upward.

Treatment. In early cases the routine treatment was traction in recumbency. Immobilization in ambulatory stage was carried out largely by plaster casts. The latter were left for a rather long period (6 to 8 months) between changes. The Thomas splint was applied with preference in children under two years of age. Heliotherapy and artificial quartz light were extensively used.

Results. Data were obtained on 276 cases which had been dismissed from the Institute for 3 to 12 years. Of these, 29 had died. Of the surviving 247, 49 complained of pain, 22 had sinuses, 155 total rigidity, 56 partial rigidity and 196 had a limp.

The end results in the 276 cases were: very good, 31 or 11.2%; good, 173 or 62.6%; moderate, 37 or 13.7%; no results, 6 or 2.1%; died, 37 or 13.7%.—*A. Steindler, Iowa City, Ia.*

TUBERCULOSIS OF THE SPINAL COLUMN. Valtancoli. *Chirurgia degli Organi di Movimento,* April, 1921.

The author's statistics are based upon 1004 cases of tuberculosis of the spine, observed in the Istituto Ortopedico Rizzoli during the period from 1907 to 1919. The disease occupied first place in frequency among the tuberculous affections of the bony system. Among 2790 cases of bone and joint tuberculosis treated in this institute, 1271 cases or 45.5% were tuberculosis of the spine.

Age. In regard to the age, the tables show the highest incidence in the third to fifth year; from the fifth year on there is a noticeable decrease until the beginning of the second decade. The highest figures are reached in this period in the seventeenth to nineteenth year. In the third decade the highest number is reached in the twenty-third and twenty-fourth year. After the twenty-eighth year there is a rapid decrease, especially in the male cases. Beyond the fortieth year the incidence becomes increasingly low.

Heredity. Positive hereditary data were found in 138 cases or 13%. In this the author's figures tally with those of others, but contrast with those of Lorenz (24%) and Gibney (76%).

Trauma. As a factor in the etiology trauma was found in 75 cases or 7.3%. These figures also correspond with those of Delitala who, in 500 cases of Pott's disease observed in the same clinic, found trauma in 5 to 10% of the cases.

Predisposing diseases. Pleurisy. This was found in 214 cases or 21%. Pleurisy

is found very rarely in the first decade and is most frequent in the 3d and 4th, where the incidence reaches 39.6 and 36.3%. It is not uncommonly found in other tuberculous lesions of the bony system, preceding the osseous manifestation, but in no other location does it reach the frequency found in Pott's disease.

Concomitant tuberculous manifestations. Of these, 198 cases or 19.7% were registered, tuberculous adenitis, tuberculous peritonitis, and pulmonary tuberculosis being the most common complications.

Localization of tuberculous spondylitis. In 42% of the cases the disease was situated in the dorsal spine, in 30.1% in the lumbar, in 15.05% in the lumbodorsal, in 6.9% in the cervical, in 3.08% in the cervico-dorsal, in 1.8% in the lumbosacral, and in 1% in the suboccipital region. The first decade shows a decided preference for high localization, while the second shows a numerical predominance for the lumbar section. In the third decade, again, as well as in the fourth, there prevail the dorsal forms. A second vertebral localization of the disease was found only in 19 cases or 1.9%.

Abscess. Lumbosacral Pott's is complicated with abscess most frequently (61%), lumbar Pott's in 40%, lumbodorsal in 32.4%. The greatest incidence of abscess formation is found in the third decade, while this complication is comparatively rare in the first.

In the first decade the forms complicated with abscess are prevalently the lumbar and lumbosacral, rarely the dorsal; in the second, abscesses are found most frequently in the sacral, lumbosacral and lumbar cases; in the third, the greatest percentage of abscesses was found in the cervical cases, as is also the case in the 4th and 5th decade.

Pain. In 760 cases or 75.6% the symptom of pain was recorded. Pain situated in the affected vertebrae is the earliest and most frequent symptom. It is often obscured by radiating neuralgic pain of the lower extremities or by intercostal or abdominal pain of referred nature. Many of the patients had been treated previously for sciatica.

Rigidity. The frequency of rigidity was found equally high, namely in 736 cases or 73.3%. The absence of rigidity and pain in 25% of the cases is explained by the fact that not all patients present themselves during the more acute stages of the disease.

Deformity. Kyphotic gibbus was found in 689 cases or 68.6%. In dorsal disease the prominence is located with the greatest frequency at the 7th dorsal; in cervical disease at the fifth cervical; in dorsolumbar disease the 12th dorsal; in lumbar disease the 2d lumbar.

A scoliotic deformity was found in 188 cases or 18.7%.

Paraplegia. There were 39 cases of paraplegia, equaling 3.9%. Its most common occurrence is in the 5th decade, followed by the second and third. The total number of cases with motor symptoms was 100 or 10%.

The duration of the paraplegia rarely exceeds one year, the condition either clearing up or ending in death. The favorable outcome occurred with prevalence within a period of 6 to 8 months. In cases in which the paralysis lasted more than a year, the mortality reached 50%. Only in 29 cases the final result of the paralysis was established: 56.8% cured, 43.2% died

Final results. As immediate results are classified those within the first five years from the outset of the disease. Of these, 612 cases are reported: 66.4% satisfactory results, 11.6% deaths. Mortality is highest during the first year of treatment, 55 out of total of 71.

Late results: Good and fair, 159 cases or 79.7%, mortality 30 or 15.1%.

The tuberculous spondylitis takes a noticeably benign course in the first decade, with 73.5% satisfactory results and a mortality of only 6.1%. In the second decade there is a moderate decrease in the number of good results and a considerable increase of the mortality. In the third decade the number of good results decreases to 30%, poor results 17.1%. In the 4th decade the mortality is 8.8%. From the fifth decade on the course of the disease become decidedly unfavorable. Mortality 19.4% in the 5th, 16% in the 6th, 100% (five cases) in the 7th.

Summing up the 30 cases of death among the late results and the 71 cases among the near results, the absolute mortality reached 101 cases or 16.5%, distributed as follows: cases complicated with paraplegia, 43.2%; hereditary cases, 18.3%; cases complicated with abscesses, 17.7%.

The increase in the mortality rate in cases observed for a long period is not surprising, considering the eminently chronic course and the frequent intermissions. Pathological investigations show that in the adult repair of the tuberculous focus does not take place by means of an osseous callus as in children, but rather in form of a pseudarthrosis, which represents an incomplete anatomical repair and should not permit one to place too much confidence in a period of quiescence. Nevertheless, one may say that in the majority of cases the outcome is favorable.—*A. Steindler, Iowa City.*

TUBERCULOSIS OF BONE: RESULTS OF A STUDY. Nathaniel Allison. *Archives of Surgery*, May, 1921.

In this study Allison discusses the variety of lesions observed in bones and neighboring tissues resulting from the different reactions of the tissues to the one infectious agent, tuberculosis. His deductions are based upon 50 cases of bone tuberculosis examined microscopically. The specimens were from the spine, hip, knee, shoulder, ankle and tarsus, wrist, elbow, trochanter major, trochanter minor, tibia, humerus, ulna, sternum, malar bone and rib. No evidence was found of a single instance of primary synovial tuberculosis, the bone being the focus from which it extended in every case. The microscopic anatomy is very thoroughly shown in the 42 figures of the text. True hypertrophy of bone was observed in several instances, which leads Allison to comment, that "When the tubercle bacillus invades tissues which in their reaction to infection readily produce new bone, the lesion observed has as one of its characteristics *new bone* formation" and in contradistinction to this he also states that, "When the tubercle bacillus invades tissues which in their reaction to infection do not readily produce new bone, the lesion observed has *not* as one of its characteristics new bone formation." Further, he states, "In all instances in this study in which tuberculous bone lesions were observed, there was both bone destruction and bone proliferation. When can-

cellous bone was involved, destruction predominated. When compact bone was involved, proliferation predominated."

Allison concludes, and rightly, I think, that the classification of tubercular lesions as observed in different tissues should be much simplified and that all the various processes observed are but the natural and usual reactions of the special tissues involved to infections, some having qualities of quickly reacting to stimulation with proliferation and others showing little or no tendency to thus react and suffering destruction.

These observations quite coincide with those of Stiles and Fraser made several years ago and with the experience of Lovett as shown on the screen at the recent meeting of the American Orthopedic Association at Boston. The microscopic examination of the tissues in Allison's series leaves no room for doubt as to the diagnosis, particularly as in crucial cases measures were taken to prove that the patients were syphilis free.—*Charles A. Parker, Chicago.*

TREATMENT OF LONG STANDING DISLOCATIONS OF THE HIP. J. Schoemaker. *Surg., Gyn., and Obstet.*, May, 1921, p. 461.

Two cases are reported of dorsal hip dislocation of long standing, one of 13 years' duration in a young woman of 23, thought to follow typhoid, and one of 3 months' standing in a man of 61, of traumatic origin. In both cases reduction was effected by manipulation under anaesthetic, using an imitation of Lorenz's method of reducing congenital dislocation of the hip. In the first patient this was preceded by 2 weeks of extension by a 6 kilogram weight, which lowered the trochanter considerably. A plaster spica was used in the frog position, and it was thought that the head gradually forced its way into the depths of the acetabulum. At the time of operation the head was thought to be left "just over the acetabulum" or "resting on the acetabulum." Dr. Schoemaker thinks that when the x-rays show normal bony outlines, even in a dislocation of long standing, an attempt at manipulative reduction should be made rather than open reduction or transposition. The femoral head must be brought to the entrance of the acetabulum with the limb placed in complete abduction after complete flexion. The young woman had two spicas each of 6 weeks, with diminishing abduction, the man had a spica for only 15 days. Both walked without a limp after recovery.—*J. A. Nutter, Montreal.*

HABITUAL OR RECURRENT DISLOCATION OF THE SHOULDER. T. T. Thomas. *Surg., Gyn., and Obstet.*, April, 1921.

Twenty-six new cases are added to eighteen formerly reported. Of the 44 cases operated 42 were anterior and 2 posterior. Both posterior cases were in epileptics and one of these had a redislocation during first convulsion after operation. Of the other 42 cases 18 were epileptics with 6 recurrences and the same number in the 24 non-epileptics. The operation advised and employed in nearly all cases is repair of the torn portion of the capsule. For

anterior dislocations the so-called posterior route is used, the incision and approach being in the axilla behind the axillary vessels and nerves. He considers a bone operation rarely indicated. The anatomical difficulties in getting adequate exposure of the torn part without danger to important structures are emphasized. The "posterior route" lessens these difficulties, but this requires very careful and accurate dissection. His results have improved with experience.—*R. W. Billington, Nashville.*

INFRACTION OF THE SECOND METATARSAL HEAD. C. F. Painter. *Boston Med and Surg., Jour.*, May 26, 1921.

Three cases of this lesion are reported in detail, all operated upon. One of these was of three or four years' duration when operated and the head of the second metatarsal had separated, forming a sequestrum. The base of the first phalanx was flared and had bone spicules around the margin of its articular cartilage. The operative findings suggest an impaction of the metatarsal head against the phalangeal cartilage. The other two cases were more recent and showed separation of the articular cartilage of the metatarsal. The condition seems to be the result of trauma such as stubbing the toe. Only a few such cases are recorded in the literature, but the author thinks they are probably not extremely rare.—*R. W. Billington, Nashville.*

A NEW METHOD OF TREATING RECENT FRACTURE OF THE OS CALCIS. David C. Strauss. *Journal A. M. A.*, July 16, 1921, p. 176.

The mechanism of the production of fracture of the os calcis is explained. The patient is anaesthetized on a Hawley table. A subcutaneous tenotomy of the tendo Achillis is performed. The latest model Steinmann pin is inserted from the mesial to the lateral surface of the heel above the body of the os calcis immediately anterior to the tendo Achillis. The protruding ends of the pin are protected by sterile gauze. Downward traction is made by an assistant forcing the posterior fragment in apposition to the anterior fragment. The anterior fragment is forced up by pressure in the arch with an orthopædic block. Downward traction and upward pressure are made by assistants while the operator applies a plaster cast. This constitutes the chief advantage in the method, since the foot is held in proper position during the application and setting of the cast.—*E. Z. Holt, Atlantic City.*

SPINAL CURVES IN GROWING CHILDREN. E. H. Bradford. *Boston Med. and Surg. Jour.*, May 19, 1921.

Spinal curvatures, in most instances, are not to be regarded as a definite disease but as a fault in growth. Treatment is not simply correction of the curves so much as the guidance of growth to a normal standard of carriage

of trunk shape. The principles of treatment are that easily tired backs should be properly rested, weak-muscled backs should be strengthened, and stiffened parts of the column should be made flexible as possible. Many practical suggestions are given as to management of faulty postures in children and mild types of structural scoliosis. Simple types of braces for both antero-posterior and lateral curves are shown. For practical purposes he divides the cases into three groups: Habit curves in healthy backs; weak backs with weak muscles or back tissues; and twisted backs with varying resistance to correcting pressure. Conclusions based on the author's large experience are: Flexible curves without structural changes in healthy patients can be restored to normal under proper guidance; this result can also be expected where some abnormal stiffness is present, though special measures may be required; fixed rotary cases need thorough measures if improvement is to be expected even in young children; it is not difficult to prevent increase of curves in healthy adolescents if carefully treated for a long period.—*R. W. Billington, Nashville.*

BACKACHE. S. Epstein. *Medical Record*, April 30, 1921.

The author mentions several of the causes of low back pain and rightly protest against the now popular habit of calling all of these cases "sacroiliac strain." He emphasizes the value of x-rays in making the diagnosis and of plaster jackets and spicas in the treatment. The article is a brief one and most of the remarks rather general.—*R. W. Billington, Nashville.*

SCOLIOSIS. S. Kleinberg. *Surg., Gyn., and Obstet.*, April, 1921.

The author has not used the Abbott method during the last four years, having found it impracticable and disappointing as to results. He now uses plaster jackets applied with the patient suspended by a Sayre halter and lateral pressure by straps over the convexities while pelvis and shoulders are fixed. Windows permit expansion of depressed areas. Jackets are repeated every month or two, getting a gradual improvement of posture and usually more or less correction of spinal curves and chest deformity. He considers structural scoliosis incurable as regards complete correction. Details of technic are described, but nothing new. He emphasizes necessity for preventive and early treatment. This extension treatment must be continued uninterruptedly for many years, changing the jackets while patient is suspended so as to avoid even momentary relapse to the previous faulty posture.—*R. W. Billington, Nashville.*

PRINCIPLES OF POSTURE, WITH SPECIAL REFERENCE TO THE MECHANICS OF THE HIP-JOINT. Mabel Elsworth Todd, M. D. *Boston Med. and Surg. Jour.*, June 23, 1921.

Dr. Todd gives a brief and comprehensive description of the intra-pelvic and the extra-pelvic groups of muscles which control the hip-joint, pelvis, and lumbar spine. Her theory is that these structures maintain the obliquity of the pelvis, the correct lumbar curve, and, in this way, the normal posture of the superincumbent thorax and skull. The head of the femur and acetabulum are likened to the hub of a wire bicycle wheel and the groups of muscles referred to above to its spokes. All these factors serve as shock absorbers and counter-balances for the different motions of the lower limbs in their support of the trunk and their maintenance of equilibrium. Dr. Todd asserts that the muscles and joints should be entirely free in their action, if the maximum of relief from stress and strain and a perfect equilibrium are to be maintained. The article is illustrated by eight excellent plates, and is a very thoughtful and logical exposition of the matter of posture in and about the pelvic girdle.—*H. A. Pingree, Portland, Me.*

THE CURE IN INFANTILE RICKETS BY SUNLIGHT: PRELIMINARY NOTE. Alfred F. Hess and Lester J. Unger. *Journal A. M. A.*, July 2, 1921, p. 39.

A preliminary note based upon the results obtained in the treatment by sunlight of five infants between six and twelve months and two between twelve and eighteen months. The legs, arms, trunk and face were exposed in turn from one-half to several hours. Every case improved. In one instance the improvement was noted thirteen days after heliotherapy was instituted. The writers recognize diet as an important factor in the etiology of rickets. They believe sun-light is also of importance.—*E. Z. Holt, Atlantic City.*

TWO CASES OF GENERALIZED LATE RACHITIS. Rendu and Werteimer. *Revue d'Orthopédie*, May, 1921, p. 215.

The authors report two cases of rachitis in girls of eleven and thirteen. Case 1 was apparently a normal child up to about twelve years, when enlargements were first noticed at the wrists and ankles. A bilateral genu valgum and a thickening of the upper end of the tibiae also developed. She had considerable pain in walking, but not much when at rest. The thickening at the wrists and ankles was quite marked and typical of rachitis but the spine and thorax showed nothing abnormal. Case 2 had similar swellings at the wrists, ankles, and upper end of the tibiae, also genu valgum. Nothing was known of the history from birth up to eight years, but the deformities did not appear until the child was about ten years old.

Roentgen rays of these cases showed stratified transverse areas of decalcification in the bones near the epiphyseal lines. The shafts were normal. Late rachitis was first described by Ollier at Lyon in 1861. Before that time the condition had been regarded as osteomalacia. Such cases are exceptional, only five being reported by Deydier in 1895. The term should be confined strictly to cases which were absolutely free from rachitis in infancy.

The etiology seems to be obscure. Among the suggestions as to the cause are: albuminuria, changes in connection with puberty, endocrine disturbance, infection.—*William Arthur Clark, Pasadena.*

Development of Cysts in Connection with External Semilunar Cartilage of the Knee Joint. R. Ollerenshaw *British Jour. of Surgery,* April, 1921.

The author has encountered cystic change in the external semilunar cartilage of the knee in three instances. Twelve similar cases are reported in the literature, all, curiously enough, involving the external cartilages. The histories are quite similar; first a slight injury followed by the development of a swelling over the external cartilage, then gradually increasing pain, and lameness. The swelling occurs at the junction of the anterior and middle third of the cartilage. It is fluctuant, but rather tense.

The author's first case had been operated on 18 months previously, with simple excision of the cyst. The growth promptly recurred. This is characteristic of other reported cases, recurrence promptly following simple excision. In one such case the cyst was excised three times before complete removal of the cartilage was resorted to. The author's three cases were operated on by total excision of the external cartilage with the cysts intact. Each case had a normal convalescence, with recovery of full function and no pain on motion.

Hemorrhagic or myxomatous degeneration of the cartilage was presumed to explain the formation of the cysts. On examination, the cysts were multilocular, lying in the outer border of the fibro cartilage. The lining was smooth and the contents a clear, mucoid material. Microscopically, the cysts were lined with flattened endothelium similar to that of the synovia. This seemed to preclude degeneration as the chief factor in the etiology. The author believes the cysts developmental in origin due to small endothelial inclusions in the cartilage during the formation of the joint. Trauma may act as the exciting agent to further development and growth of the cyst. Other observers have not noted the presence of endothelial lining in the cysts, regarding them as degenerative in origin. Some classify them as ganglia. All, however, agree upon their tendency to recur after simple excision. No explanation is offered to their predilection for the external cartilage.—*J. W. Snyder, Rochester, Minnesota.*

CEREBRAL SYPHILIS OR CERVICAL RIBS. Dept. of "Instructive Mistakes," *British Jour., Surg.*, April, 1921, p. 529.

A woman aged 46 was admitted with the diagnosis of "cervical ribs" because of weakness and wasting of the ulnar group of muscles of the right hand. The x-ray showed a cervical rib on each side. The diagnosis was only doubted after note was made of transient unilateral facial paralysis. This suggested cerebral syphilis, which was confirmed by cerebrospinal fluid examination and the Wassermann test.—*J. W. Snyder, Rochester, Minnesota*

TRAUMATIC SPONDYLOLISTHESIS; REPORT OF TWO CASES. S. Kleinberg. *Archives of Surgery*, July, 1921.

Kleinberg reports two cases of this rare condition coming under his observation in which the dislocation forward of the fifth lumbar vertebra was disclosed by the x-ray. One was in a laborer 55 years old who had been struck in the back by a beam and knocked down and was confined to his bed for eight weeks, after which he gradually resumed walking, but with much painful effort. An examination at this time showed a marked hollow of the back just above the top of the sacrum and pressure here caused severe pain and disability. The x-ray showed the fifth lumbar vertebra displaced forward with the anterior part of the body depressed in front of the sacrum, establishing the diagnosis of spondylolisthesis.

The other case was that of a man 35 years of age who some months previous to the examination was carrying a heavy weight on his back, when suddenly another weight was added, causing it to "cave in," as he expressed it. He felt severe pain in the lower part of his back but continued his work and kept on working for several months longer, when increasing pain and disability finally made him give up all work. The distinct hollow above the top of the sacrum suggested the diagnosis of spondylolisthesis, which was confirmed by x-ray. In this latter case the ability to carry on his work to some extent would seem to discredit the diagnosis of so formidable a condition, but Kleinberg mentions five cases he had seen with Dr. Darling in which the disability was of a similar benign type. He believes that the x-ray appearance is pathognomonic, the stereoscopic views rendering the exact pathology quite clear.—*Charles A. Parker, Chicago.*

A CONSIDERATION OF THE ETIOLOGIC FACTORS IN MYOSITIS OSSIFICANS TRAUMATICA. Charles F. Painter, M.D. *The Boston Medical and Surgical Journal*, July 14, 1921.

Dr. Painter reports one case of ossification in muscular tissue which he has seen recently. The condition appeared some weeks after an injury to the muscle and was complicated by a synovitis of a nearby joint. Removal of the osseous material, followed by baking and massage, produced marked improvement.

Many writers upon the subject are quoted, but after a perusal of their theories as to causation, none seems to fit all cases, and one is forced to the conclusion that the condition is not yet well understood. Dr. Painter suggests that a certain diathesis or dyscrasia exists which, when subjected to repeated trauma or violence, produces myositis ossificans.—*H. A. Pingree, Portland, Me.*

Concerning the Pathology of Curvature of the Radius. Pilatte. *Revue d'Orthopédie*, May, 1921, p. 223.

In these cases of bowing of the lower end of the radius the roentgenogram shows the radial styloid below the ulnar styloid. The idea that the deformity is due to shortening of the bone does not hold. Masmonteil, who seems to be sponsor for the shortening idea, says he has seen a condition exactly like the Madelung deformity which followed fracture and subsequent shortening of the radius. However, the hand is deviated toward the radius in case of such a fracture while the deviation is almost always toward the ulna in the Madelung wrist.

The fact that the lesion is bilateral in about two-thirds of the cases is further evidence against the theory of shortening.

Tillier, in studying the development and structre of the radius, has demonstrated a weak point in the bone just above the epiphyseal line. It is possible that this point of least resistance is the cause of the curvature. The fact that the curve is backward is explained by the predominance of the flexor muscles. —*William Arthur Clark, Pasadena.*

Surgery of Peripheral Nerve Injuries of Warfare. H. Platt. *British Medical Journal*, April 23, 1921.

This admirable paper should be studied carefully in the original text, and serves almost as a standard in the modern treatment of peripheral nerve injuries. It is based on a personal series of 510 operations and affords a wealth of general as well as specific information on this subject.

The frequency with which the ulnar nerve called for treatment, the infrequency of operations on the brachial plexus, the complete absence of any operation on either the musculo-cutaneous, circumflex or anterior crural nerves are especially noteworthy. Two hundred and forty-eight early and late results are investigated. These operations included 150 cases of end-to-end suture, 80 of neurolysis, and 18 of bridge operations. The end-to-end sutures gave 118 or 79% of recoveries.

While improvement has occurred in the neurological syndrome after the operation of neurolysis in 75% of cases, it has been impossible to prove that the operation itself alone has determined this. Therefore, the limitations of the operation of neurolysis as a definitive factor in the surgical treatment of the warfare lesions of nerves are to be fully realized.

From a series of 25 operations performed for severe causalgic manifestations,

the author concludes that the efficacy of the operation of early resection and suture for severe causalgia is beyond criticism, and is certainly a more exact procedure than the equally, or even more destructive method of alcohol injection.

The Hunterian Lecture, of which this paper is a part, invites careful perusal as the work of an authority, and is the best article so far on this subject.—*Ellis Jones, Los Angeles.*

AUTOGENOUS BONE TRANSPLANTATION. Melvin S. Henderson. *Journal A. M. A.*, July 16, 1921, p. 165.

The paper is based upon the experience and results obtained at the Mayo Clinic. Bone transplantation has been performed on four hundred and thirteen patients during eight years. One hundred and sixty-six of the number were operated upon for tuberculosis of the spine. Nearly the entire remainder were operated upon for ununited fractures. Of the traceable cases operated on for tuberculosis of the spine, fifty per cent. were regarded as cured or as having the disease arrested. Twenty-nine per cent. were improved, twenty-two per cent. were unimproved, nine per cent. died later, and two and twenty-six hundredths per cent. was an operative mortality. Of the traceable cases operated on for ununited fractures, seventy-nine and three-tenths per cent. were successful, eighteen and eight-tenths per cent. were failures and one and seventenths per cent. of the patients died. The author is certain that his results have been improved by using the massive graft and clamping in to the fragments by aid of beef-bone screws.—*E. Z. Holt, Atlantic City.*

OBSERVATIONS ON THE NORMALLY DEVELOPING ELBOW. Isidore Cohn. *Archives of Surgery*, May, 1921.

Whoever has had to deal with the x-ray of the injured elbow of a child six years old will appreciate the value of this series of roentgenograms presented by Cohn, covering the various phases of the x-ray appearance of this multiepiphyseal articulation from the age of 17 months to the seventeenth year. With a series of 24 joints, he represents practically all the stages of development with anteroposterior and lateral views.

A detailed knowledge of the x-ray appearance and time of appearance of all the main centers of ossification should be a part of every surgeon's primer.—*Charles A. Parker, Chicago.*

FOR BETTER TREATMENT FOR CRIPPLED CHILDREN. H. L. Langnecker. *California State Journal of Medicine*, April, 1921.

The writer makes an appeal for special legislation to provide for the education of crippled children whose physical disability prevents attendance at the regular public schools. The adoption and favorable working of the Educational Amendment would solve this problem in California, and the support of the profession is asked to obtain enactment.—*Ellis Jones, Los Angeles.*

THE STANDARDIZATION OF METHODS OF TREATMENT IN ORTHOPÆDIC SURGERY AND INDUSTRIAL SURGERY OF THE EXTREMITIES AND SPINAL COLUMN. R. B. Osgood. *Illinois Medical Journal*, April, 1921, pp 342 to 352.

This is a brave attempt in one journal article to cover a very large field of surgery.

There are at least 30 headings and subheadings discussed in the eleven pages, starting with "Tuberculosis of Bones and Joints," and finishing with a general statement on the care of compound fractures. The author was impelled to undertake so arduous a task by the great differences he had observed in the methods of treatment and the time required for common conditions under the care of equally qualified surgeons. He combines orthopaedic with industrial surgery, as they are both extensively concerned with the surgery of the extremities. The surgery of the spine must also frequently be considered in industrial surgery as well as in orthopaedic surgery. Taking up the topics *seriatim*, he first considers tuberculosis of the bones and joints, emphasizing the difference in care in children and adults—in the former following the dictum of Kirmisson: "Jamais résection, jamais résection," but in the latter following the dictum of too many others: "Once we have made a positive diagnosis of tumor albus in an adult whose full growth has occurred, our next step is to set the day for excision, and, unless the joint is very acute as a result of trauma or too great use, the earlier we set the day, the more perfect weight-bearing and useful limb shall we secure."

In further discussion of tuberculosis of the adult knee in which excision is the rule, he says: "We have never known an adult tuberculous knee premanently to recover useful function without excision or erasion." The author, of course, means a useful limb rather than the knee-joint, as resection or erasion should ankylose the joint. With this understanding as to useful function, the author has been unfortunate in his treatment and observation not to have seen many adult knees that have healed and the limb become useful under careful and consistent fixation methods without operation. It is quite probable that the adult tuberculous knees that are in the stage giving the best results from excision will also give equally good results from proper nonoperative treatment, the same as in children, and the patient working while wearing the apparatus: while the disorganized and secondarily infected knees of adults will not give good results by either method, amputation being the measure of choice.

Spine. "We consider the routine employment of homogenous bone grafts or extensive ankylosing operations on the spine in tuberculous disease in young children is still *sub judice*." In adults, he condemns bone grafting operation with faint praise.

Rickets. Speaking of bow-legs and knock-knees: "There may be methods of choice in individual cases, but the large series of successful end-results of the osteoclases of Blanchard and the epiphyseal slidings of Codivilla should make us slow to condemn these rather rough—one may say almost brutal—but quite safe methods."

Adolescent Rickets—coxa vara. Favors abduction under full anesthesia, and cast.

Scoliosis. No standard method; very dubious outlook. However, there should be a note of optimism, as many of the future cases of scoliosis are now being prevented by early care of the trunk in infantile paralytics.

Congenital Deformities. Favors bloodless methods in congenital hips, but is open to conviction if other surgeons can duplicate Galloway's recently reported large percentage of cures by operative methods.

Believes *clubfoot* treatment should begin the day it is discovered, by manipulations, adhesive plaster and casts, and later by Ober's operation, when previous measures have not been used or are unsuccessful.

Poliomyelitis. Early protection against deformity is urged and later tenotomies and transplantation of tendons advised when necessary.

"The intra-sheath method of Biesalski and Mayer represents theoretically the most perfect technique, but we are not yet convinced of its habitual necessity in the light of end-results." He also advocates unremitting training of the remaining musculature as the last step in connection with what stabilizing operations are needed.

Foot strain and Faulty Weight-Bearing. "Restoration of normal balance is the standard treatment." This he amplifies to include exercises, apparatus and special shoes.

Osteomyelitis. "We believe that Dakin's solution and Carrel's meticulous technique have shown better results than any others, and what is significant, these results have been repeated by other surgeons who have omitted no essentials of the methods."

Joint Infections. He refers particularly to the acute types and believes most infections, unless there is frank pus in the cavity, will be overcome by lavage of the joint for ten minutes with a saline or mild aseptic fluid. Following this, the synovia should be closed and will rarely need to be reopened. He also quotes Willems' experience with small incisions and voluntary movements of the joints—principally the knee—as being successful in properly selected cases, but he does not favor resecting septic joints. After clean operations on the knee he advocates early resumption of voluntary movement.

Amputations. He favors a properly performed Syme's amputation and the early use of a weight bearing plaster pylon in leg and thigh amputations to inure the end of stump to pressure. Strapping has proved valuable in the treatment of sprains. Complete reduction and incomplete fixation are advocated for dislocations.

Fractures—Spine. Advises operation when pressure symptoms do not suggest severance of the cord, and rest and recumbency for those not producing cord injuries. He suggests the possibility of ankylosing operations as the method of choice in the future. Fractures of the transverse and spinous processes are not to be considered so important.

Clavicle. Lying on the back with a pillow between the shoulders is suggested as the best method, although a posterior cross of wood or plaster is good for ambulatory treatment.

Shoulder-joint. Replacement of dislocated head and abduction for these and fractures of the surgical neck.

Shaft of Humerus. Jones' humerus traction splint.

Elbow-joint. Acute flexion except in olecranon fracture.

Both Bones of the Forearm. A plaster cast extending above the elbow and below the wrist with the forearm extended and almost fully supinated.

Colles' Fracture. Break up impaction, correct rotation, put up in plaster with palmar flexion and ulnar deviation.

Carpal Fractures. Excision is given as the method of choice when reduction is not possible.

Pelvis. Recumbency, belts, or plaster spica.

Hip-joint. He discusses intracapsular fractures and strongly recommends the abduction and inward rotation methods, employing plaster, traction, Thomas's splint, Jones's abduction or Balkan frame. He also reports the good results of the Maxwell-Ruth method.

Fracture of the Upper Two-Thirds of the Femoral Shaft. The Thomas leg splint is given as the standard treatment.

Fracture of the Lower Third of the Femoral Shaft. He prefers the ice tongs in the condyles with traction.

Knee-joint Fractures. Reduction and early resumption of voluntary movement.

Fractures of the Patella. Operative treatment is the method of choice.

Both Bones of the Leg. Advocates the Parham band in oblique fractures. Tenotomy of tendo Achillis in fractures of the lower part, if necessary to secure position.

Fractures of the Ankle. Correction of deformity and plaster of Paris.

Fractures of the Astragalus and Os Calcis. Correct deformity by molding or otherwise. Astragalectomy occasionally justifiable.

Compound fractures. Advocates thorough chemical and mechanical cleaning of wound and early closure. In closing, he makes a plea for the possession of seven standardized traction splints by all industrial plants, as traction is the most important factor in the treatment of fractures of the long bones and joints.—*Charles A. Parker, Chicago.*

AN ADJUSTABLE EXTENSION AND SUSPENSION "BALKAN" FRAME. Nathaniel Allison. *Surgery, Gynecology and Obstetrics,* May, 1921, p. 459.

Dr. Allison here describes and pictures a Balkan frame made of one and one-sixteenth inch iron tubing, capable of being adjusted to any hospital bed of standard dimensions. Its description is given in order to emphasize the value of suspension treatment of fractures and joint injuries in our civil hospitals, and to interest others in having available in our hospitals, for immediate use, a frame made of tubing, which will not present the disorderly appearance of the wooden Balkan frame. The device is not claimed to be new in any of its principles.—*J. A. Nutter, Montreal.*

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The Journal *of* Orthopaedic Surgery

OSTEOCHONDRITIS OF THE UPPER EXTREMITY OF THE FEMUR.

BY DR. JAQUES CALVÉ, BERCK-PLAGE, FRANCE.

THIS affection is not clearly individualized except in the radiographic findings. With its etiology disputed and its pathogenesis obscure, its clinical manifestations are poorly defined and its evolution almost entirely unknown. Most of the observations published are incomplete and show only one of the phases—some one particular moment—of the affection. This lack of information results, first, because osteochondritis is a rare condition, and more especially because it is found particularly among hospital patients who are easily lost sight of.

Two cases which I had the good fortune to observe are herewith presented. They synthetize—in my opinion—all the other rare cases scattered throughout medical literature. Their analysis brings a little order into the confusion surrounding this condition and affords some new conclusions.

The first observation is that of a child of three and a half years, of the well-to-do class, who in September, 1915, during the course of a chicken pox suffered slightly with pain in the right hip. Radiographs of the hip were taken, although the pain disappeared almost immediately. The x-ray plates revealed a normal hip. The child recovered from the varicella and resumed her normal life. With the exception of an occasional slight defect in walking from time to time, nothing drew attention to the right hip until the end of 1916.

more than a year later, when the child began to limp and complain of pain in the knee. Examination showed limitation of the movements of the hip; the diagnosis of coxalgia was given. The child was put to bed and treatment by immobilization begun. A radiograph revealed lesions characteristic of osteochondritis; the femoral head was in place, the clear articular space enlarged, the epiphyseal nucleus modified both in form and substance; it was flattened and fragmented.

When I saw the child for the first time in 1918, I discarded the diagnosis of coxalgia and gave a diagnosis of osteochondritis. A radiograph taken at this time showed that the epiphyseal nucleus had augmented in volume and now formed a single round cap-shaped mass. Two and one-half years later, in 1921, a further radiograph showed the epiphyseal nucleus of still greater volume, and of a more regular form, tending to approach the normal. Since 1918, the child has walked without fatigue and has had a normal life.

From this observation, we can deduce that, (1) osteochondritis is not a congenital affection; (2) that the phase of the invasion of the epiphyseal nucleus is latent from the clinical viewpoint; (3) that the clinical phase corresponding to the period when the child first begins to complain of pain is considerably later than the real beginning of the trouble; (4) that to the beginning of the clinical phase there is a corresponding radiographic picture showing an established and characteristic lesion—a laminated and fragmented epiphysis; (5) that the regeneration of the osseous epiphyseal nucleus occurs progressively, as the osseous fragments augment in volume, approach each other, reunite one by one, and finally form a single mass. This regeneration continues through the following years and tends to a return to the normal form.

I have formerly described this regeneration of the osseous nucleus in my first publication in 1910; this regeneration is constant in all the observations if one takes the trouble to look for it. Equally constant is the astonishing variance between the radiographic findings and the first clinical manifestations. This variance, which seems to have been unnoticed until now, proves indisputably that the debut of the trouble, whatever its cause—infectious as in the preceding observation, traumatic, or specific—is clinically silent.

In the second case, that of an English child at Queen Mary's Hospital at Carshalton, all of the interest lies in the examination of the different radiographs made from year to year.

In the first, one can determine an entire absence of the epiphyseal osseous nucleus which one sees regenerate itself at first fragmentarily,

and then in the following radiograph, into a single mass. The important fact of this observation is to show that the destruction of the epiphyseal osseous nucleus may be total and that notwithstanding this, regeneration takes place and finally results in a voluminous epiphyseal nucleus. As regards the clinical history, that of the second child was not noticeably different from that of the first.

These two observations, it seems to me, permit us to look at osteochondritis in a new light. It is a cyclic disease which commences in a healthy child in the first years of life, continues its development, and finishes its course, but leaves after it an acquired malformation, a deformed articulation. The clinical signs do not show themselves during what may be called the inflammatory period of the affection. If they exist, they are slight and pass unperceived; it is only when the femoral head has become deformed in the course of regeneration that the painful phenomena become evident. They are comparable to those which recur from time to time in all articular malformations. They do not arise from an arthritis, but rather from a functional strain. The femoral head, flattened and enlarged, does not adapt itself easily to the cotyloid cavity with which it articulates; the head is, as it were, too large for too small a hat, and it is this fault of adaptation which causes the pain.

To the generally accepted theory which sees active inflammatory lesions in infantile osteochondritis, is opposed this theory of mine of an acquired malformation. The succession of events is something like this: under the influence of infection or traumatism, in a young child in whom the femoral epiphysis possesses a thick cartilaginous shell, the epiphyseal nucleus is partially or totally destroyed,—suppressed—without injury to the neighboring articulation, which is protected by the thickness of the epiphyseal cartilaginous shell. Then the osseous nucleus begins to reform, at first fragmentarily, in irregular and not typical fashion, provoking a more or less accentuated deformation of the cartilaginous epiphysis. This latter, probably under the action of the weight of the body, subsides lightly upon itself, from whence comes the enlargement and flattening characteristic of the affection.

CONCLUSIONS.

The term "osteochondritis" appears defective, for it seems to indicate an affection in full inflammatory evolution. I prefer to substitute for it the term "coxa-plana" proposed by Waldenstorm; it is short and makes clear the fact that the characteristic of the disease

is an acquired articular malformation characterized by the flattening of the superior femoral epiphysis and the regeneration of the epiphyseal osseous nucleus; the articular contacts take place in defective fashion and frequently bring about, under the influence of fatigue or a spurt of growth, painful phenomena comparable to those of all articular malformations. These conclusions have not merely a theoretical interest. It is easy, however, without insisting too much upon them, to deduce from them the matter of practical interest, the *treatment* of the condition.

Historical.

If we eliminate the juvenile arthritis deformans of the old German writers (Hoffa, Zezas, Bruns, and Perthes, before 1910), which is a different disease attacking the articular surfaces which it partially destroys, and on the other hand, bordering on the formation of osteophytes, the two papers which first present the subject of osteochondritis are those written by Legg and by myself, in 1910.

Legg published, February, 1910, the text of a communication made by him in 1909 at the Congress in Hartford.

I published, July, 1910, the observations already recorded in Sourdat's Paris thesis, July, 1909. I emphasize this phrase of Sourdat's: "The discussion of these chronic arthrites will be renewed constantly by Dr. Calvé, whom I thank for permitting me to publish here these observations and these radiographs."

DICUSSSION OF DR. CALVÉ'S PAPER

DR. FRED H. ALBEE, New York City: I do not believe that I can add much to the discussion of this paper by Dr. Calvé. I do, however, wish personally to thank him for the original work which he has done on this disease, and for making this journey here to present his work. I have not had the opportunity to see very many of these cases, but I have been impressed with the fact of its not being necessary to carry out very rigorous treatment. Many of the cases hardly need immobilization, but those with spastic muscles do need immobilization and support for a varying time.

I was much interested in the cases that Dr. Calvé demonstrated. The first case was especially interesting, and I wish again to thank him for his paper.

DR. F. J. GAENSLEN, Milwaukee, Wis.: I think we are very fortunate indeed to have Dr. Calvé here today to tell us of his further studies concerning this interesting condition. I visited him in 1912 when he showed me some of these cases, and ever since that time I have been on the alert for them. I also had occasion to revise the diagnosis on some older cases which I had regarded as so-called quiet hip disease. While most of these cases are very characteristic both as to clinical and x-ray findings, there are some which are not so readily recognized. I recall one in which the symptoms were very acute and in which the limitation of motion was not merely in abduction, but more or less general. The x-ray showed a lesion in the neck as well as in the hip. I could not definitely exclude tuberculosis

and, since the joint still seemed not directly involved, I decided to operate. I have slides of tissue removed which I shall be glad to show.

Dr. Osgood: Thank you. Will you please show the slides?

Dr. Gaenslen: Dr. Calvé's case is most interesting because he had the opportunity of observing it so long before the characteristic symptoms came on. It is probably the only observation of the kind made. In my own case, the pathologist, Dr. Thalhimer, concluded from exclusions that there might be imperfect osteogenesis. That theory would not be quite in accord with the findings of Dr. Calvé, in that he found the epiphysis normal fully a year before the radiograph showed the characteristic changes.

Dr. Osgood: Is Dr. Legg here? I am sorry, gentlemen, that you have not the opportunity of hearing from the author of the disease.

(Dr. Gaenslen showed his slides)

Dr. Gaenslen: In this first slide there is seen a fairly normal arrangement of the cartilage cells in rows with normal epiphyseal line formation. I assume this to be on the shaft side of the epiphysis.

In the second slide the opposite side of the epiphysis is shown, presumably that toward the head. Here cartilage cells are disposed very irregularly, often forming irregular columns, and there is also imperfect bone formation. Here there is no regular epiphyseal line formation.

In my own case, cultures made at the time of operation showed no growth. In a case recently reported by Phemister cultures were also negative. These two observations will throw some doubt on the findings of other observers who found staphylococci present.

Dr. Edwin W. Ryerson, Chicago: It seems to me that there may be two causes: one, traumatic; and the other, infectious, as Dr. Calvé once suggested. An x-ray picture that I have here seems so characteristic of an infection that I should like to pass it around. The medial third of the neck of the femur seems to be softened, as though by disease, and the head itself shows the characteristic flattening seen in the typical Legg-Calvé disease. I should like Dr. Calvé's opinion about this picture. It is a case that has been going on for six months. It seems to me very much like an infectious process. As the disease has progressed, the appearance of softening in the neck of the femur has gradually decreased. The neck is now almost normal, but the head is very flat.

Dr. John Ridlon, Chicago: If I got the drift of Dr. Calvé's paper, it seems to me that his conclusion should be that we cannot make the diagnosis until the case is entirely finished. If it is true, that we cannot make a diagnosis until the case is finished and we have the entire series of x-ray pictures, and if we cannot make a tentative diagnosis, assuming that we have a case with acute inflammatory symptoms and the typical picture of flattened head and broken up head, what is the diagnosis and treatment if a tubercular abscess develops, as it has developed in two cases of mine?

Dr. Osgood: Will Dr. Calvé answer the questions? One was in relation to treatment. Have you a treatment to suggest?

Dr. Calvé: Only rest, but not for so long as is generally ordered.

Dr. Osgood: And in relation to Dr. Ridlon's question, do you think that it is sometimes easy to mistake this for early tuberculosis of the hip?

Dr. Calvé: I do not think so.

Dr. Osgood: Is is usually fairly easy to diagnosis it early?

Dr. Calvé: I think so.

AN OPERATION FOR STABILIZING PARALYTIC FEET.

BY MICHAEL HOKE, M.D., ATLANTA, GA.

In making anything the artisan must know the material he is to fashion and have a definite idea of what he intends to make. This is as true of plastic surgery as it is of any other manual art.

The results we seek and produce by operating upon a paralytic foot depend upon an accurate, detailed knowledge of the architecture of the normal leg and foot skeleton, of the deformed leg and foot, of the relation of the weight thrusts to the architecture, and of the relation of these to the action of normal muscle power and the disturbances of muscle power produced by paralysis. It is impossible to convert a paralytic, deformed foot into a normal foot. What, then, can we put down as a standard type of result to be obtained by a method which produces the result with sufficient frequency to make it useful and worthy of our recommendation? It seems to us that feet that have been operated upon should possess the following qualifications: First, they must look natural in shoes; second, they must be so stabile that they will not turn laterally on the long axis of the foot when the patient is standing and walking; third, they must be so stable in the natural or nearly natural attitude that they do not need braces to hold them so; fourth, when barefoot they should look natural or, if that be impossible, nearly enough so to present no gross deformity. For example, a bad club foot often cannot be made natural in appearance. If it shows slight mid-tarsal and metatarsal varus, but the placing of the foot on the ground is correct, one would consider the result a finished one for this particular foot.

Only since we have learned to do this operation have we, in Atlanta, been able to obtain results that meet the above requirements. We have tried for several years to find an architectural operation which was reasonable in principle. This one seems so and has been surgically satisfying.

Tendon transplantations have, in our experience in the past, been distinguished by their failure, except in a few cases. We have regarded tendon transplantation done alone as unmechanical. We have regarded the fixation of tendons to bone to control lateral deformity as unmechanical and have, therefore, done no operations of this nature. We have done no silk insertion operations for this purpose for we did

not believe they would hold against the powerful body weight thrust. We have not done Davis' operation for it is done blindly and does not take into consideration the architectural details which we think are fundamental if one would produce results filling the above qualifications.

From 1914 to 1817, the brace-free feet we could produce were those upon which astragalectomy was done. Astragalectomy, except for the calcaneus type of deformity for which Whitman devised it, and possibly for flail feet, is certainly an objectionable operation.

We did the first one of these stabilizations in January, 1917. In 1917 we did some astragalectomies and some stabilizations. Since the middle of 1917 we have done the stabilization operation alone, or in conjunction with tendon transplantation. The operation has been done in 104 cases in the Scottish Rite Crippled Children's Hospital up to January, 1921. We have had the opportunity to see only 57 cases of the 104 at the end of periods varying from six months to three years after operation. All have been stabile. One case showed sufficient gross deformity to need better balancing by operating again.

In our clinic today, the stabilization operation is made the fundamental basis of all surgical plans for paralytic feet that show much architectural deformity and much loss of muscle power, for we believe a stabile, skeletal foundation is necessary if we would repeatedly obtain the desired result.

Why should the skeleton be stabilized? Between the foot and leg there is universal joint motion. Necessary as it is for flexibility of the foot possessing normal muscle control, it is not an easy thing for normal muscles to control and stabilize it. One has only to think of the flat feet of children and the foot strains of adults to suggest the difficulty.

Think how well a patient can walk on an artificial limb after an amputation below the knee. The patient with a bad paralytic foot deformity walks worse than the patient on the artificial limb. Structurally, the artificial limb is a stable thing to stand on. Suppose you should insert a universal joint between the foot and leg part of the artificial limb. Imagine the use it would be to the patient. And would he be satisfied with the job if a mechanic should tack strong strips of leather across the joint? No. They would not hold against the body weight thrust. The patient himself would suggest the removal of the universal joint and that the apparatus be made stable again.

After muscle balance has been upset and much power lost by paralysis, and the architectural changes have taken place in the skeleton, the

patient walks on a unversal joint over which he has no control. He has lost the stability that normal muscle power and brain control gave him. We do not think he can get his stability again and keep his universal joint motion. We think it necessary to do away with the universal joint motion.

It is fortunate that the motion between the foot and leg, though of a universal joint type, is a compound of motion in three places, namely, the ankle-joint, the subastragaloid joint and the astragalo-scaphoid joint. For good function it is necessary to retain the aknle joint. For architectural reasons, which imply the retention of a shapely ankle and posterior foot, it is necessary to retain intact the articulation and bearing points between the astragalus and tibia and fibula. It is necessary to stabilize the subastragaloid and the astragalo-scaphoid joints. This operation does this, and enables one at the same time to correct the posterior foot deformity.

There is some difference in the details of the operation on the various types of feet, for the architecture of a drop foot, a club foot, and a flat foot are quite different. And then, too, there are mixed types. The difference lies mainly in the way the head of the astragalus is replaced. It is put back in a certain position for drop foot, a certain position for flat foot, a certain position for club foot, etc., so that we type the stabilizations in the operating room as "drop foot type of stabilization," "flat foot type of stabilization," "club foot type of stabilization," etc.

Since it is the purpose of this paper only to make clear the reasons, as we see them, for stabilizing the feet under discussion and to report the fundamental details of the operation, which we now know will stabilize them in an advantageous way, we will use for illustration a simple type of foot, a drop foot with no posterior foot architectural deformity, a foot in which there is much lateral instability, a foot over which muscle control has been lost, except in the weakened but not totally paralyzed gastrocnemius-soleus, the flexor longus digitorum and the flexor longus pollicis. To carry the idea a little farther, we will point out the things of interest in the architecture of two other types; a flat foot and a club foot, and the application of the operation to these types. A little later we will go over the various types that have been done and report them in separate papers.

Description of the Operation.

The skin incision extends from over the external portion of the head of the astragalus downward and backward to the peronei tendons

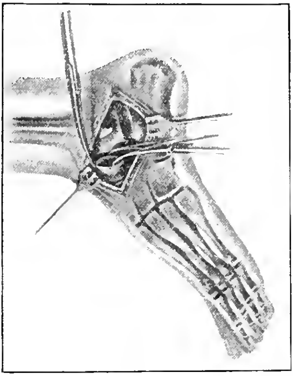


FIG. 3.

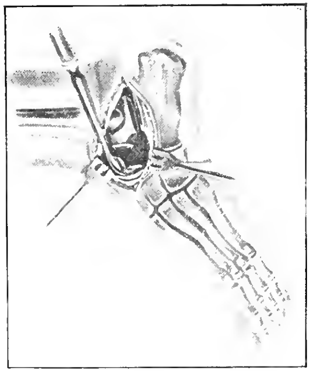


FIG. 4.

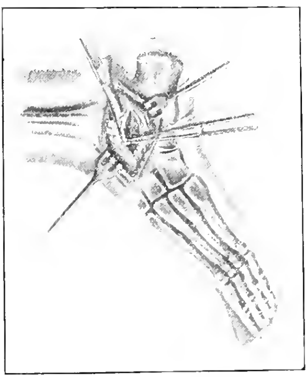


FIG. 1.

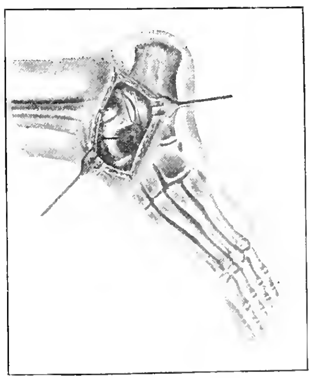


FIG. 2.

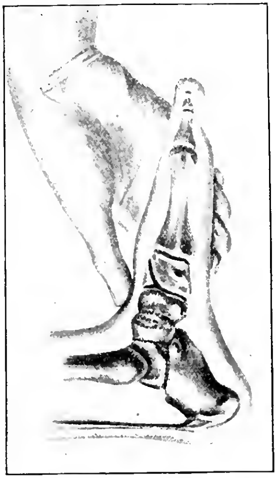


FIG. 7.

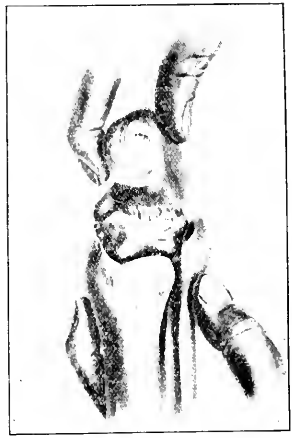


FIG. 8.

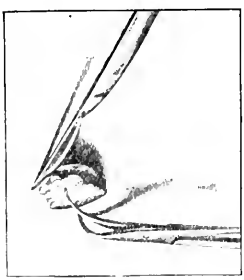


FIG. 5.

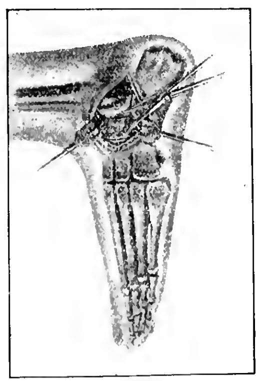


FIG. 6.

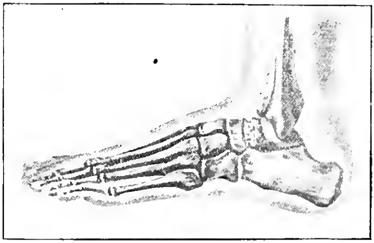


Fig. 9.

Fig. 10.

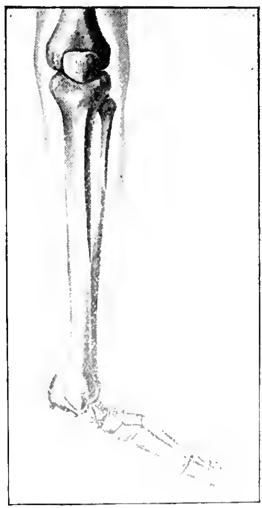


Fig. 11.

below the end of the fibula. The incision and exposure shown in the illustrations are different from the incision and the exposure made at the operation. To show the bone details, the artist had to disregard other things. Give the name "subastragaloid fossa" to the space bounded above by the neck of the astragalus, below by the superior surface of the os calcis and behind by the body of the astragalus. The adipose tissue occupying the subastragaloid fossa is split. The upper portion of this tissue is grasped and dissected out (see Figure 1), so that the under surface of the neck and adjacent portion of the body of the astragalus is denuded of all tissue. The inferior half of the tissue occupying the subastragaloid fossa is dissected out so that the superior surface of the os calcis is bare. Shift a retractor so it will lift the structures above the neck of the astragalus. With the knife point hugging the bone, the superior surface of the neck of the astragalus is made bare of all tissue. Next, free the head of the astragalus from the scaphoid, cutting the astragalo-scaphoid ligament, with the knife beginning low and externally and sweeping around the head, ending internally. With hammer and osteotome, a portion of the inferior surface of the body of the astragalus is removed. A portion of the adjacent surface of the os calcis is removed. Next, the neck of the astragalus is cut through where it joins the body. Figure 2 shows the bone cuts. The amputated neck and head of the astragalus is grasped with sharp pronged forceps. A spoon-shaped instrument is slipped in between the head of the astragalus and scaphoid. The head of the astragalus is levered partly out. The remaining attachments are cut with scissors (see Figure 3). The neck and head of the astragalus are placed in a towel and laid on the instrument table. The cartilaginous surface of the scaphoid is then denuded with a curette (see Figure 4). The cartilaginous facet on the superior surface of the os calcis, on which the foot rotates laterally on the head of the astragalus, is denuded with a small chisel.

In a pure drop foot we are not confronted with architectural deformity of the body of the astragalus and the os calcis, but in the other types of deformity one finds that at this stage of the operation, with the head and neck of the astragalus out and the body of the astragalus freed from the os calcis, he is able to correct the posterior foot deformity, to set the posterior end of the os calcis in line with the center of the leg, to shift the os calcis laterally in line with the central axis of the leg, to correct lateral rotation of the os calcis, to pitch the heel up or down, and to shift the foot back, as Whitman has pointed out as so essential in his astragalectomy. The posterior foot is

subject to the operator's wishes and the setting his fingers may give it. The head and neck of the astragalus, that was laid aside for a moment in a towel, is taken in forceps and the cartilage on the head is shaved off with a knife just to the bone beneath it. (See Figure 5.)

Refer again to Figure 2, and you see the neck of the astragalus is quite long, curved and a little hooked down. The weight thrust is transmitted to the anterior foot by the head of the astragalus and in the direction of the axis of the neck. Such a type of astragalus contributes architecturally to the pitching downward of the anterior foot. If you now cock up the anterior foot and retract the wound, you will see that the amputated head and neck piece is too long to go back. Hold the piece on a 3 x 3 x 1 wooden block and cut off with hammer and osteotome just enough of the posterior end of the neck so that when you put the head and neck piece back, it will nestle in place between the scaphoid and body of the astragalus without obstructing the cocking up of the anterior foot. Be sure to "sink" it down on the upper surface of the os calcis. It is necessary at times, in order to "sink" the head, to cut off a little of the under surface of it.

The foot is held by the operator as in Figure 6, and until the plaster is set he continues to hold it so. The assistant sews the subcutaneous tissues with interrupted No. 1 catgut sutures. The skin is sutured with interrupted silk sutures, being careful not to infold the skin. Plaster is applied to the knee, being careful to hold the foot as in Figure 6.

In addition to the paralysis of the anterior muscles, there are three other things that contribute to the drop foot gait after the condition has been present for a long time. First, the motion between the head of the astragalus and scaphoid, which is much greater than normal, due to ligament stretching; second, the lengthening, and in many instances, the hooked-down curve in the neck of the astragalus, and third, the structural pitching down of the shafts of the metatarsals. In the setting after operation, one cannot always correct the downward pitching of the shafts of the metatarsals to the desired degree. If he cannot, then, after the foot has been in plaster five weeks and the cast comes off, the patient is given an anaesthetic and by manipulation of the centre of the tarsus, it can be forced downward and the anterior ends of the metatarsals lifted up. This will correct the metatarsal architectural feature without disturbing the setting of the posterior foot (see Figure 7). The foot goes back in plaster for two weeks. We find that 6½ to 7½ weeks for children and 8 to 9 weeks for adults, is the proper length of time to keep them in plaster. The

Fig. 12.

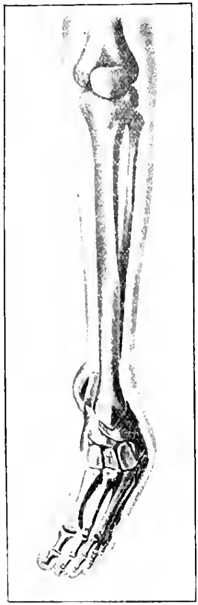


Fig. 13.

Fig. 14.

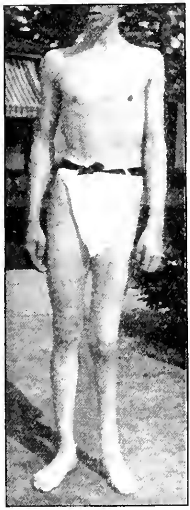
after-treatment consists only of about two weeks' massage and the putting on of a shoe.

Figure 8 and Figure 9 show the fusion that occurs.

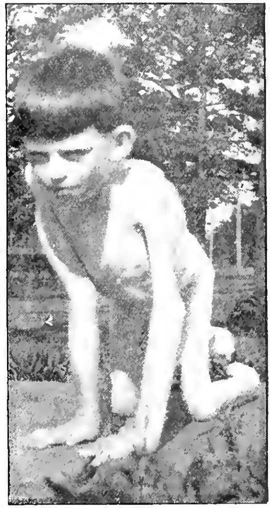
The end result for the above type of case is a foot that possesses the qualifications of the end result desired and mentioned in the beginning of this paper. The toe swings clear of the ground without a high knee action effort, with one exception. When the quadriceps extensor is quite weak, with the hamstring and gastrocnemius-soleus muscles strong, and the anterior group below the knee totally paralyzed, a lifting knee action is most difficult to do away with, and is oftentimes not done away with.

Figure 10, an anterior view, shows the normal architecture of the leg and foot skeleton. The axes of the knee and ankle are well in

CASE I.



CASE I.



CASE II.

line; there is no twist in the tibia; the axis of the neck of the astragalus, if prolonged forward, passes through the anterior end of the first metatarsal. The architecture, the axes of the joints and bones, the relation of the weight thrusts are suitable to the preservation of the natural attitude of the leg and foot under normal muscle control.

Figure 11 shows the architecture of the leg and foot of a paralytic flat foot of pronounced type. How different from the normal! Note the torsion of the tibia which throws the relation of the axes of the knee and ankle out of line; the breadth across the neck of the astragalus; the downward and inward pitching of the neck and head of the astragalus, and note that the scaphoid has slid upward and outward on the head of the astragalus and that the shafts of the metatarsals are almost parallel with the horizontal ground surface. The arrow through the neck of the astragalus defines the action of the weight thrust. Can one with an appreciation of the above considerations expect anything but a skeletal operation to fit such a condition?

Figure 12 shows the application of the "flat foot type of stabilization" to this type of architectural deformity. Note the position of the

CASE II.

CASE III.

reimplanted head of the astragalus where it should be placed in this type of the procedure. If it were put back in its former position, relapse would occur. If it were put back in the normal position, relapse would occur. With the scaphoid placed a bit to the inner side and under the reimplanted head, as depicted in Figure 12, relapse will not occur, if, too, all other deforming factors are removed. Note the correction of the torsion of the tibia by the tibial osteotomy. Note the transplantation of the extensor propius hallucis to the internal cuneiform bone.

Figure 12 shows a type of architecture of the leg and foot skeleton seen in paralytic club feet. Just as different as the flat foot type is from the normal, is this, in other details, different from the normal and the flat foot types. There is one detail alone that is like the flat foot type, namely, the torsion of the tibia. The shape and the position of the neck and head of the astragalus, the direction of the axis of the neck, the position of the scaphoid in its relation to the head of the astragalus, the way it is tied to the head by ligaments, the position of the os calcis

with reference to the central axis of the leg, the relation of the shafts of the metatarsals to the ground horizontal are all different.

Figure 13 shows the alignment of the leg after correction of the torsion in the tibia, the application of the club foot type of stabilization and the transference of the attachment of the anterior tibial to the centre of the tarsus. Note the position of the reimplanted head of the astragalus. It is necessary in some club foot cases to replace the head somewhat internal to the position in which it is placed in this illustration.

Photographs of types of cases before and after the stabilization operation are included in this paper to show the appearance of feet before and after the architectural correction.

It is the purpose of this paper to report the operation which we have found to be useful, and therefore feel like recommending to others to try out, to focus their attention on the fact that the architecture of the deformity to be dealt with must be considered, that the alignment of the leg is important, that, in our opinion at least, the universal joint motion must be done away with, and that this operation permits this to be done and enables us at the same time to correct the posterior foot deformity.

DISCUSSION OF DR. HOKE'S PAPER.

DR. A. BRUCE GILL, Philadelphia: It is unusual and gratifying to find the almost unanimous expression of opinion here this morning as to the necessity of skeletal fixation to stabilize the lower extremity, particularly the foot. Orthopaedic surgeons have been trying for years by means of operations upon the soft parts to stabilize the foot, but are now coming more and more to the realization that an arthrodesis or skeletal fixation is the operation of choice.

I cannot speak too highly of the work of Dr. Hoke. Indeed, it speaks for itself and needs no commendation from any of us.

I desire merely to point out how similar is the operation of Dr. Hoke to the subastragalar arthrodesis of the late Dr. G. G. Davis. These two master orthopaedic surgeons arrived independently at almost the same end long before nearly all other surgeons were ready even to accept the principle of skeletal fixation. The subastragalar arthrodesis of Davis produces a fusion of the astragalus, the os calcis, and the scaphoid. This fusion is secured by a thorough digging up of the joint surfaces by means of gouges, without the removal of any portions of bone from the wounds. Dr. Hoke likewise secures an arthrodesis of the same joint. It may be stated here that the subastragalar joint includes the articulation between the scaphoid and the astragalus together with that between the os calcis and the astragalus. Dr. Hoke removes the head of the astragalus, cuts off its cartilaginous surfaces and restores it to such a position as to allow correction of the existing deformity of the foot. In the Davis operation, after the subastragalar joint is thoroughly gouged up, the foot can be moulded and placed in any position desired. It can be moved from side to side, rotated inward or outward, moved forward or backward, because nothing but the soft tissues maintain connection between the foot and the leg in the horizontal transverse plane beneath the astragalus. If the head of the astragalus so projects as to in-

terfere with the proper reduction of deformity it is removed in pieces with the gouge, and the fragments are allowed to assume whatever position they will as the foot is put into the correct position beneath the leg. These fragments of cartilage and bone assist in producing a thorough fusion between the bones.

It may here be stated that the triple arthrodesis of Ryerson is the subastragalar arthrodesis of Davis plus another thrust if the gouge between the os calcis and the cuboid. If the subastragalar arthrodesis is done thoroughly, an additional arthrodesis of the os calcis and the cuboid is unnecessary.

The point to be emphasized is that an arthrodesis of the foot is essential to the permanent and satisfactory correction of deformity and production of stability, and that the operations of Hoke and Davis alike give such splendid results because they are identical in principle and differ only in smaller detail.

Dr. Charlton Wallace, New York City: Dr. Hoke is certainly to be complimented upon his mechanical genius. If I understood him correctly, the whole object of his operative procedure in this type of work is to establish weight bearing and walking ability in the foot; also to bring about a normal line of gravity by the operation upon the tibia. He also secures stability. One's own personal experience will certainly lead one to adhere to the operative procedure that secures these three things best for the patients and withstands the test of time.

The weight of the body is transferred to the foot through the body of the astragalus. It is almost the same as if a marble were put in the middle of the foot. It is next to impossible, through tendon transplantation *per se*, to obtain a stable walking foot, because there has been lost one of four of the pulls trying to balance the foot upon a marble. Therefore, for a decade or more some of us have not been attempting to do tendon transplantations alone upon these feet. My experience is such that I am a through advocate of astragalectomy as performed after Dr. Whitman's method; even for muscles where there is adduction deformity of the foot and an overacting tibial muscle, the astragalectomy can be combined with a tendon transplantation. Therefore, in stabilizing the foot, I have personally adhered to the astragalectomy. It obtains some things that we have heretofore never been able to secure. It gives good weight bearing and walking function to the foot. It is also preferable to any operation that I know of where both feet are involved. There is some suspicion of shortening where it is a unilateral affliction, but that is so inconsequential that its consideration is really not worth while. It is hard to get, in this discussion, in so short a time, one's experience.

From having worked on these cases ten or twelve years and observing, perhaps, anywhere from a hundred and fifty to two hundred and fifty cases, I can say this: I have absolutely not, in any case that I have ever operated on, observed an instance in which the patient was not materially benefited by the procedure. There has been a gain of function after the operation. The immediate loss of shortening obtained by the operation is counter-balanced by the gain in lengthening, comparatively speaking, that one gets in most of these cases by the time the patient is twelve or fifteen years of age. We have, by that time, only three-quarters-of-an-inch of shortening. It prevents delayed shortening by the increase in the circulation in the foot, and in the cases where chilblains occurred before the operation they do not recur afterwards. The child is young and must develop and does so much better if able to stand and walk without braces, and certainly these children so play without braces. The physiological use stimuates the growth of the affected extremity.

I have watched these cases for years after they were operated upon. Only the other day a boy of eighteen reported to me at the Reconstruction Hospital. He had had an operation on both feet seven years ago. In one lower extremity he had activity and power only in one hamstring. There was absolutely no power in a muscle below the knee. He is now a farm laborer and

wears no brace. It was most gratifying to see this boy come in and say that he was doing ordinary common farm labor. I do not know any other operation that would give this boy that power.

Dr. Osgood: Dr. Hoke, will you please close the discussion?

Dr. Hoke: May Dr. Wallace state what age he would prefer for the operation?

Dr. Wallace: Six years; but I have done one or two cases at the age of three. The age of the patient is not the indication of the time to operate. One operates on these cases from two to three years after the original onset. I have done some cases as early as the age of three years.

REPORT OF THE COMMISSION APPOINTED TO INVESTIGATE THE RESULTS OF ANKYLOSING OPERATIONS OF THE SPINE.

E. G. BRACKETT, M.D., W. S. BAER, M.D., J. T. RUGH, M.D.

The Commission has confined its report to data based on the cases personally examined by its members, and the aim of this report has been to give the results of the operations on tubercular spines, performed with the object of producing ankylosis. The two principal methods of operation, namely, fusion and inlay graft, have been used in practically all of these cases, with the exception of a few cases in which a combination of the two was used. No attempt has been made for a comparison between the methods of operation, other than to present the data obtained, for the object of the Commission has been to present the results of ankylosing operations of the spine, in order to determine the value of this procedure in these cases. No differentiation of relative influence of mechanical treatment and of operative treatment on the course of the disease has been made, and in the large majority of cases it is not possible to differentiate the results of the operative procedure alone, for the reason that in so many cases it has been an incident in the course of treatment, and the mechanical treatment which had been begun was continued for long periods afterwards.

It would not have been possible to find, from the return cards alone, the necessary data to compile a report, as the information contained

was not sufficiently complete and accurate for use. Also, it seemed evident, that for the sake of uniformity, the individual equation of the operator should be eliminated. It was decided to use only the facts obtained by personal examination of the patients, and of the x-rays, by the members of the Commission.

Letters and circulars were sent to all the surgeons of the American Orthopaedic Association and also to surgeons, not members of the Association, but known to be active in orthopaedic work. From these, a certain number of questionnaires have been received, and deductions drawn which may be used to give either impressions or opinions obtained by a large number of competent surgeons, and which must be considered separately from the report of the Commission. As a rule, the records kept were not sufficient to furnish data. Also, many institutions have suffered from the loss of x-rays which form the most valuable data for record, and in many cases these x-rays have suffered a wholesale destruction, in addition to those which have been lost because of lack of proper system of filing and storage.

The Commission has been greatly handicapped by the laxity of methods which the individual members of this Association have pursued in keeping proper records of their cases. The situation is the same with regard to the hospitals with which the members are connected. With few exceptions, the proper data necessary to the work of this Commission have been unobtainable; the follow-up system in most of the hospitals has been woefully lacking—practically does not exist. In one hospital only, and that one served by a man not a member of our Association, have complete and accurate date been obtainable and furnished to the Commission.

The results of the fusion operations are from practically one operator and treated under the same conditions: the great uniformity of these results, and the excellent condition of these patients are a distinct indication of the influence of the character and the technique of the operation and of the operator and the systematic attention to the immediate after-care. The choice of the case, the technique of the operation, the character of the subsequnet care, are large factors in determining the end-result.

The features of special importance bearing on the clinical course of these cases have been considered, and the cases studied with reference to them. In making this report, the Commission has demanded, besides a sufficient history of the case, an x-ray picture of the case before operation, the case itself in person, an x-ray picture of the case immediately following the operation, and x-ray pictures at least

two years after the operation has been performed. The following features of the operation were studied:

1. The influence on the subsequent development of deformity.
2. The arrest of the destructive process.
3. The influence on the acute symptoms.
4. The production of fusion of the bodies of the vertebrae.
6. The effect on abscess.
7. The effect on paralysis.
8. The operative risk.
9. The functional results.
10. Mortality.

1. The Influence on the Subsequent Development of Deformity.

The ankylosing operations alone, by either method, cannot be depended upon to prevent the increase of destruction or deformity. Apparently, the deformity does increase equally with the operative and with the mechanical, as ordinarily employed in this country. The deformity is not always proportionate to the added destruction of the bodies of the vertebrae, as it may vary in the usual course of these cases, by the gradual development of compensatory curves. Cases in which the mechanical treatment has been continued for long periods following the operative method, have, in general, shown a markedly less degree of deformity, than those cases in which mechanical treatment was abandoned early, or inefficiently carried out. This is particularly true of children

The development of deformity naturally is influenced by the age of the patient, and the records show a very much larger percentage and also degree of increase among the younger children during the plastic and growing periods. To determine the data on this feature, the cases have been placed in three groups: The first includes those under five years, the second those between five and sixteen years, and the third those over sixteen years. Results are shown in table on page 510.* It is to be seen, therefore, that deformity is not materially influenced by the operative methods of treatment, unless supplemented by thorough mechanical support, for these results include cases of both lumbar and cervical disease, in which the amount of deformity in the convalescent periods is not marked as a rule.

The later examination of these cases shows that too much dependency cannot be placed on operation, either by fusion or inlay, to protect the spine against further development of deformity, or to prevent strain of the back in the ordinary course of daily life of the patient.

So far as this fact is concerned, operative interference must be looked upon as an incident in the course of treatment, and the protective and supportive treatment in children must be continued almost as long as in cases in which operative method is not used. Not only can the inlay bend with increasing curve of the spine, and yet remain in position, as has been beautifully shown in one case, in which there was a large increase of deformity, and in which x-rays indicated that gradual development of the knuckles and the change in the shape of the graft correspond to the changed position of the spine, but also, the inlay may break even after a considerable period. In all of these cases symptoms reappeared.

The experience with a number of the cases has shown that too much dependence must not be put on the protection afforded by the inlay itself. Although this may vary largely with the size of the graft, it is probably not due to the size alone, since fracture has occurred in the cases of all the operators who have used the inlay method, and this has also occurred in one case of fusion. This fracture of the graft has happened in a period varying from one to three years. Although the statement has sometimes been made that the rupture of the graft does not materially influence the fusion of this part of the vertebrae, this has been shown to be erroneous, as in a majority of these cases showing a fracture of the graft, acute symptoms have reappeared. In one case, the graft broke both above and below the two diseased vertebrae, but held between the spinous processes of the two bodies, which showed destruction. This case showed a good functional result. Another case showed a fracture, or a failure of union between the spines

* TABLE.

Number of cases examined		96
Abscesses before and remained		10
Abscesses before which disappeared		8
Abscesses appeared after operation		7
Paralysis before and remained		1
Paralysis which disappeared		7
Paralysis after operation		2
Infection		2
Cases under 5 years		32
(Increase in deformity	24)	
Cases 5 to 16 years		48
(Increase in deformity	32)	
Cases over 16 years		16
(Increase in deformity	5)	
Ankylosis		77
Fusion		18
Mortality		3
Number in complete block of cases		176
Mortality		16

of the last diseased vertebra and the vertebra below. This case did not show ankylosis, and had only a fair functional result. One case showed a fracture of the graft three years after operation, following which symptoms developed; in another case, a fracture developed eighteen months after operation, while the patient was lifting a heavy weight. Although this experience demonstrates the value of the graft, so long as it is firm and in position, it also suggests the necessity of a large and firm inlay.

Ankylosis of the Operative Field.

The ankylosis in the operative area cannot be determined by the x-ray, particularly in the case of the fusion operation. In the case of the inlay, the graft can be easily seen in place, and its integrity demonstrated, but the ankylosis in the posterior part of the vertebrae, which is, of course, to be desired, cannot be shown either in the antero-posterior or in the lateral view. The presence of ankylosis was determined by the symptoms, the immobility shown by examination, lead tracings in different positions, etc.

In the great majority of cases (80%), ankylosis of this area was found to be present, the percentage varying directly with the age of the patient.

Fusion.

Ankylosing operations have had apparently little effect on the production of ankylosis of the bodies of the vertebrae. Among the cases examined, 18 showed actual fusion of the vertebrae, and these were cases in which four or five years had elapsed since the observation made by the first x-ray. In these, there was complete fusion of the diseased area, which gives the ideal end-result, and which alone can be called an absolute cure. These cases were all in the younger subjects. No instance of fusion was seen in the adults.

Influence of the Operation Upon Acute Symptoms.

Although the successful ankylosing of the posterior part of the spine by either method may not seem to arrest the development of deformity, it undoubtedly does exert a favorable influence on the acute symptoms. While the available records in the large majority of cases do not give sufficient data as to the presence or absence of acute symptoms before and after operation, the evidence obtained from those in which records were available supports very strongly this opinion. In spite of rather imperfect mechanical fixation, the acute symptoms even with

the ambulatory cases in the early post-operative period, and in the cases treated in the hospitals in which after-care is not well under control, the occurrence of after-symptoms was, on the whole, rare.

Abscess and Paralysis.

The effect of the operation upon abscess or paralysis cannot be determined in this series, since cases of both abscess and paralysis are too few to give sufficient data upon which to base an opinion. The information obtained, however, warrants the conclusion that in both of these conditions, the operation exercises a favorable effect. Whether or not this is in part due to the recumbency following the operation is difficult to determine, but it is highly probable that enforced rest exerts a distinctly favorable influence.

Mortality.

The records of these cases show two distinct and important features namely, that this operation itself is not one attended by a large mortality, and also that infection is not to be expected, as this was recorded in but two cases. This is equally true of the inlay and the fusion operation. In computing this, the deaths which occurred within two months of the operation were considered as operative, whereas, those occurring in a later period were considered as due to some intercurrent disease, or possibly to exhaustion, which may have been aided by the shock of the operation.

The figures which are given by the return cards show the fallacy of determining results by data on the ordinary questionnaire, at least in the present state of record-keeping among medical men in general, and this includes both hospital and private records.

In 163 cases from which data were returned, from different operators, only three deaths were recorded: two of these were post-operative occurring within two years after the operation, and one, operative mortality. This gives a very low percentage of mortality for an operation of this magnitude. On the other hand, when a complete series is followed, and complete data obtained upon a series as a whole, with the end-results in each case, the element of mortality assumes very different proportions. In the one series in which these records have been obtained (this series is comprised of a definite block of cases done within a definite period of time), and in which the end-result was obtained in practically every case, the mortality assumed rather alarming proportions. 16 cases of death in 137 cases operated. In this group of 16 cases, three were classed as operative, occurring

within two months of the operation, six were recorded as due to meningitis or pulmonary tuberculosis, a cause which could be considered indirectly connected with the disease. The other cases must be considered as due to intercurrent disease,—influenza, whooping cough acidosis, etc. This series is most valuable, particularly when compared with the data received in the ordinary questionnaire. It emphasizes in the strongest manner the value of following up the final results, in order to establish data on this problem of end-results, with operation or any form of treatment. It also shows the need of following up cases requiring long convalescence in order to establish the fact of complete recovery and to determine the value of any particular form of treatment. The figures given in this series do not necessarily indicate a greater mortality of the operator, but suggest what has probably happened to a large number of cases of all operators who have not a complete record of the end-results. In one other smaller series, in which the records kept were far above the average, three deaths were known to have occurred in a group of 18 collected from a series of 37. These were all in the post-operative period, and would have been regarded as probable successes had not the end-result been accurately followed up. These figures also show the absolute necessity of reports being made only upon such cases as can be examined personally by a Committee, and also the necessity of complete records of both before and after conditions, in order to make a report of value

The age in which operative interference should be attempted is a question. The mortality among the younger children certainly shows a much larger ratio, not only in the operative period, but also in the post-operative period. Whether or not this is due to the exhaustion of a rather severe operation cannot be determined, but it would be suggestive, since in the series of 16 deaths, one-half died within the first year, although of intercurrent or allied disease, in which the exhausted condition may easily have played a part. In view of the imperfect ossification in this early period, the advisability of operation on the younger cases, it is still more essential that the rigid apparatus treatment should be thoroughly and long continued.

The operation should be regarded as an incident only in the treatment in these cases, and the fixation and supportive mechanical treatment should be carried on sufficiently long to afford opportunity for the ultimate fusion of the bodies, if such a result is possible. A cure can hardly be considered as assured until the child has passed the second period of growth.

This investigation has demonstrated certain valuable facts in regard to these operations. It has also demonstrated that to follow up the true end-results of any group of cases, a new era in the methods of record and follow-up must be instituted. In one group only has this record of a group of cases been possible, but which proves, however, that the task can be done. Unless the end-results of practically all of the cases may be had, the conclusions will be futile, and they will err on the side of producing more, rather than less, favorable results than actually exist. It is to be suggested, however, that the system of follow-up be advised, or a definite method of examination and record, and that all those interested in such information should collect such data as might be used in the future for an investigation and study, such as has been the object of this Commission.

DR. DAVID SILVER, Pittsburg, Penna: The Committee is to be congratulated on the completeness, impartiality, and judicial character of its report. The work is sufficient evidence of the great value of this form of investigation. I came here with a number of points which I considered of especial importance but practically all have been covered.

It seems to me wise that the Committee has left the question of the preferable method of operation undecided, as there would naturally be a considerable difference of opinion on that point; there is evidently no question however, that, when properly performed, a successful anklylosis can be secured by either method, so that the problem becomes one mainly of the effect on the symptoms, the extent of the deformity, and the final function.

I do not recall that anything was said of the danger of pulmonary embolism following the inlay graft; this, I think, should be included, as one of my cases had such an unfortunate ending.

Especial study, it appears to me, should be made of the effect on the function of the spine from the standpoint of the extent of the segment ankylosed. In the early stage of the disease we have no definite means of determining how far the disease has extended and of course cannot know how far it may extend subsequent to operation; we must, therefore, extend our operation well beyond the recognized limits of the disease and so ankylose a fairly large segment of the spine, so that the end-results from this standpoint cannot possibly compare with those obtained by the natural methods of healing.

DR. E. W. RYERSON, Chicago, Ill.: I was, unfortunately, not able to hear the earlier part of the report. The proposition is simply a mechanical one in my opinion. We know that if the spine can be held still long enough, most cases of tuberculosis of the spine will get well. Whether we get them well more quickly by operation than by mechanical treatment, is, to my mind, the important question. We can fuse the spine by any one of various methods. It takes an immense length of time for uncomplicated tuberculosis itself to fuse the spine. It takes years, and dozens of years, in many cases, for tuberculosis without secondary infection to fuse the spine. Cases with abcesses fuse more rapidly than those without abcesses. It is my belief that a fusion operation is warranted in any case in which the patient is a good operative risk, barring small children. I no longer do these fusion operations on children, if time is no particular object. I think that adults who have tuberculosis of the spine should have a fusion operation, if they are good operative risks.

With regard to children, the operation does not shorten the length of treatment very much. You have to go on treating them with apparatus for a long time, but patients so treated do not show the tendency to recurrence that unoperated cases do. It is appalling to see the cases come back that were not operated on. They come back ten or fifteen years after we believe that they were cured, some with pain, some with abcess formation, and some with paraplegia. I believe that the operation is fully justified by the results in properly selected cases and where the operation is properly performed.

Dr. Osgood: We are fortunate to have Dr. Calvé with us, and he is willing to discuss this paper.

Dr. Jacques Calvé, Berck-Plage, France: It is not my intention, in this brief paper, to contrast one therapeutic method with another. I desire only to show the results obtained through the French method of treating Pott's disease among children, with my modification, and to analyze these results.

This treatment in its general outlines consists in:

First, requiring the patient to maintain a recumbent position for a minimum of three years.

Second, placing the vertebral column in hyper-extension,—following rules which vary according to the location of the lesion, with or without the application of plaster apparatus.

Third, having the patient live in the open air—preferably at the seashore—giving him the greatest possible benefit of the sun cure and supplying him with healthful and abundant food—avoiding over-nourishment.

The cases in this series are of children. Pott's disease presents a different problem in adults.

A child under this local and general treatment possesses the marvelous quality of becoming entirely cured, in the anatomical sense of the word; of producing cicatrization of the vertebral lessions. In the case of a child, Pott's disease passes a veritable cyclic evolution: an infiltration phase, followed by one of ulcerous destruction, and it is only in the third year of this evolution that the process of building up commences, and this is completed between the third and fifth year—according to the capacity of the patient to cicatrize, and to the extent of the lesion. Never, in the course of the autopsies made at Berck upon children afflicted with Pott's disease, and dying from other causes, has any trace been found of the reparation process prior to the third year. We cannot insist too strongly upon this fundamental fact, too generally unknown.

The cicatrization is at first fibrous, afterwards bony. In a closed focus of Pott's disease this bony reparation is never accompanied by a bony neoformation, as in the case of an area of a fracture, or a focus of osteomyelitis. Bony consolidation must be obtained by juxtaposition. There is never a bony growth thrown out between two surfaces separated one from the other.

Corrective changes of the more or less acute angular deformation which is characteristic of Pott's disease are gradually produced during these processes of healing and treatment. These corrective processes—some, spontaneous, the others provoked—develop either in the focus itself (these are intra-focal corrections), or above or below that focus (these are the extra-focal corrections).

It is especially in regard to these phenomena of correction that I shall attempt analysis, and I shall illustrate them by radiographic views taken in profile both in the lumbar and dorsal regions, and by outline drawings.

Lumbar Pott's Disease. The lumbar region favors two methods of correction:

First—Extra-Focal Corrections.

These are easy to obtain, the lumbar region being normally hyper-extensible; it is the region of the lordosis. To obtain rapidly the compensatory curves, both directly above and below the focus, it is sufficient to place the patient in progressive hyper-extension, either by means of a plaster bed, a block of wood placed under the mattress, or by using a curved frame.

Second—Intra-Focal Corrections.

Some are obtained early in the treatment, and some later.

(a) *Early corrections are easily obtained.* They occur spontaneously and rapidly as the destruction progresses, when the patient is recumbent and in hyper-extension. An anatomical disposition—peculiar to the lumbar vertebrae—explains these corrective phenomena; the pedicles and the arcs are not as high as the bodies and the discs. In the vertebral focus covering two vertebrae, the lower articular process of the upper vertebra can settle backwards and downwards; no obstacle interferes with this movement. But, on the other hand, it is facilitated by the bony groove on the posterior and lateral faces of the lamina. At this same time, with this destruction there occurs a physiological settling of the arcs and spinal processes, which only ceases when the point of the superior articular process of the lower vertebra strikes against the upper posterior surface of the inter-vertebral foramen of conjugation.

(b) *Late corrections.* Phenomena of a different and very important nature follow these phenomena of physiological correction about the third year; the laminae and the pedicles diminish in height by the action of the constant, dystrophic process, in the vicinity of a focus of bone tuberculosis. Finally, an added posterior settling is produced when the destruction of the body is considerable. The upper vertebral body slips slightly backward, and the upper articular process of the lower vertebrae ascends into the inter-vertebral foramen.

Two vertebral bodies can lose 7/10 of their height with a corresponding compensation in the disease area,—that is to say, there should never be any lumbar gibbosity.

Dorsal Pott's Disease.

In contrast with the lumbar, dorsal Pott's disease is a far more difficult problem. This is in the region of large gibbosities; everything tends toward their development—the weight of the body, breathing, the normal kyphotic form, the normal physiology of the dorsal sector, because it is the centre of the movements of flexion, and it is impossible (in the movements of extension) to pass the upright position. Dorsal hyper-extension does not exist normally.

Contrary to that which exists in the lumbar region, the laminae and the pedicles are of the same height as the bodies of the vertebrae; posterior physiological settling is impossible. As soon as the disc is destroyed, the centre of the movements of flexion, which, normally, is found at the junction of the posterior third and the anterior two-thirds of the disc, is much displaced backward to the point of the superior articular process of the inferior vertebra; the two infected vertebrae crush together, pivoting around this point; this later is rammed against the inferior surface of the superior pedicle on a slippery surface of compact, burnished tissue, which conditions are eminently favorable to this movement of dipping forward; the equilibrium of the superior vertebra of the focus on the inferior vertebra becomes unstable just as is the case in a pair of scales where the beam oscillates on its fulcrum.

A dislocation of the vertebral articulations is the result; the laminae become separated, and "yawn" open backwards.

Recumbent treatment suppresses one of the most important factors of the aggravations, namely, the weight of the body. It partly annihilates the unfavorable action of the respiratory movements. However, no matter how early the treatment may be begun, there is almost always a notable angular deformity shown by the X ray as a cuneiform focus with a posterior basis.

What corrections are to be hoped for under these circumstances?

Intra-Focal Corrections.

(a) Early ones: There are none.

(b) Late ones: They are very slight; about the third year of the evolution of the disease, a diminution in the height of the supporting articular process, (the one that serves as a pivot), and of the pedicles can be noticed, from which results a slight settling. The spinal process of the upper vertebra in the beginning is prominent, because it is almost horizontal, and later becomes shortened, and curves inward during the third year.

Extra-Focal Corrections.

Here is the knot of the question. It must be insisted upon.

Dorsal Pott's disease, because of the impossibility of hyper-correction—with the dorsal sectors adjacent to the focus above and below—can be compared to a fracture of a long bone which is knitting in a vicious position at an angle of deviation opening to the front. The patient is bent double, and if a means of redressing this forward inflexion were not found, it would be impossible for the patient to regain the attitude of a biped,—that is, for him to stand erect. This is the aim of the entire treatment. It could easily be attained, and even spontaneously, but at the price of a great deformity. It is easy, indeed, to provoke, or even to allow, compensatory curvatures in the physiologically hyper-extensible regions of the spine—above and below the focus—to establish themselves, but at a great distance from each other in the cervical and the lumbar regions. This is what happens in dorsal Pott's disease treated irrationally; the erect position is re-established, the position of a biped is possible, but at the price of a considerable dorsal deformity. The healthy sectors adjacent to the sectors above and below, which are not normally hyper-extensible, contribute to forming the gibbosity, whence the origin of a large, dorsal hump. The consequences, besides the deplorable aesthetic results, are grave; crushing of the thorax, insufficient haematosis, interference with the cardiac circulation, and—as a result—cessation of the body's development.

The orthopaedic surgeon must prevent the formation of this gibbosity. Since as we have seen, he should not open up the focus by separating the affected vertebrae, because in all bony tuberculosis there is no bone growth without contact, neither can he, on the other hand, hope for an intra-focal settling. He must, therefore, apply his treatment exteriorly to the focus.

In the first place, he must prevent the formation of spontaneous and physiological compensatory lordosis, both cervical and lumbar. The large plaster corset, called "Minerva", going from the occiput to the coccyx, brings about this result.

Next must be provoked in the healthy segments of the spine, immediately above and below the focus, compensatory curves called artificial or therapeutic curves, as distinguished from spontaneous or physiological ones. It is by patiently, during months of time, applying a continuous pressure, a slow propulsion on the focus and especially immediately above and below, that one succeeds, in some manner, in overcoming the normal physiology of the spine, and according to Wolff's law, in modelling the adjacent healthy vertebrae and discs above and below the seat of disease.

Little by little the vertebrae open very slightly in front, the pedicles and laminae atrophy and curve inward, the articular processes diminish in height, and one thus succeeds in creating a corrective hyper-extension.

The result obtained must be maintained.

To gain this end, and to avoid the ill results of wearing too long the "Minerva" plaster corset (deformation of the chin, lengthening of the neck, and muscular atrophy) it is necessary to alternate the treatment by placing the patient in bed in total hyper-extension (plaster bed, curved frame, or

large block placed under the mattress). To obtain this result will require three years at the minimum.

From the analysis of these different facts it becomes very evident *that time is the prime factor* of our treatment.

It is not our intention to discuss generally the treatment by osteosynthesis; we only say that it is incompatible with our treatment. A graft in an early stage would prevent the progressive evolution of the corrective phenomena. Later on, it would be useless, since the focus has totally cicatrized. At the most, the advisability of a short graft in the dorsal region might be considered which would be applied only to the affected vertebrae, and on condition that no change should be made in the general treatment or in the duration of the recumbent position. Osteosynthesis could be added to our treatment in the dorsal region, but it could not replace it.

Several objections have been advanced against our treatment. The long period in the recumbent position is alleged to be injurious from a physiological point of view. Fifty years of experience in France, based upon the treatment of thousands of her children, make a positive response to that allegation. It suffices to pass a few days at Berck to convince one's self that the recumbent position brings no injury to the physical or moral development of the child.

This treatment is also alleged to be too expensive to be applicable to the poor.

Very poor reasoning, is our answer, for in trying to economize in the present they are piling up a large debt to be paid in the future. Those afflicted with Pott's disease, when insufficiently treated, are subject to relapses, and death or grave deformities are the results thereof, and from this is cast upon the country either a loss of life or a serious financial burden.

In our opinion, the creation of centres for treatment of tuberculosis of the bone, similar to that at Berck, would be of great advantage in the control of this disease. The patients and those connected with them would be disciplined; specialists would be created and trained.

It should always be borne in mind that every child who is afflicted with Pott's disease is the bearer of other lesions of the same kind, sometimes recognized clinically, but most often latent. For several years, the child should live in the open air far from town, and in such centres of treatment where it would receive the delicate and minute attention that its local and general condition require.

DR. GILL, Philadelphia: I wish to ask the members of the Commission a question. When a section of the spine is ankylosed by means of a bone transplantation or by a fusion operation, it would appear likely that the portions of the spine immediately above and below the ankylosed section are subjected to abnormal motion and strain to compensate for the absence of motion in the fused section. Did the Commission find any evidence to indicate that secondary foci of tuberculosis occur in these portions of the spine that are thus subjected to abnormal strain? Or, if they do so occur, do they appear here more frequently than in other portions of the spine? Within the past month I have seen three cases in which a secondary tuberculous focus had appeared just above or below a bone transplant, with no evidence to indicate that the disease was a direct continuous extension from the original focus.

DR. A. H. FREIBERG, Cincinnati: I think that we shall all go away feeling that nothing that we have done here will be more valuable in our future work than the discussion that we have had on the Report of the Commission, on the one hand, and the paper of Professor Calvé, on the other hand. The lesson that we should take away with us is, that everything we do must be done in such a way as to square with what we know of pathological physiology and what we know happens to the diseased segment of the spine, just as Ménard was able to show, in the old days of enthusiasm for forcible correction of Pott's deformities; we know that the disease cannot get well un-

less the surfaces are in apposition, and that the tuberculous foci are not placed where new bone formation can be expected to occur within a reasonable length of time. Indeed, it may not occur at all; so we must learn here that the graft which we place in the spine is only a more efficient method to assist us to splint the spine for a length of time, and that we cannot dogmatize in either direction. I might even accuse our distinguished guest, Dr. Calvé, of dogmatizing too much in his article in the *Revue de Chirurgie* some time ago, where he stated that whereas the vertebrae in the child fuse readily, those in the adult do not. But I have in mind the case of a woman of twenty-seven years, with paraplegia, in whom, after long immobilization treatment without operation, I got a perfect fusion, such as we get more often in the child, showing that the thing can happen. I think the lesson will be most practical, if we go home and study all the details with careful, mature, frank thought.

Dr. J. T. Rugh, Philadelphia: I want to call attention to just one error in the reading of the paper. Dr. Brackett has given me permission to correct it. It was a slip of the tongue, and might create a false impression.

The statement was made that, of the eight cases of paralysis, seven had persisted, giving a percentage of 85, and one had recovered. Exactly the opposite took place. That is, following the operative procedure, or the long rest combined with it, the seven cases of paralysis disappeared, and one remained.

I think that the work of the Commission has been probably of more value to its members than it will prove to the members of the Association but the members of the Commission feel that they would like the members of the Association to participate in the advantages that we have enjoyed. It has shown undoubtedly the marked advantage of long fixation, and my own personal views have changed decidedly towards operative procedures. I am still strongly inclined to the operative treatment of these cases, and will continue my operative work. I feel however, that our best results will be obtained after the age of fourteen or sixteen years. I feel that I shall continue to do the operation in children, believing that when the graft has taken hold or the fusion of the spine has been accomplished, that child, when it has attained adult life, will have a greater fixation of that spine than it would obtain under the simple mechanical treatment of the condition. I have secured the fixation of the posterior, as well as the anterior portion of the column. This, I feel, is one of the best safeguards that can be given to that patient.

One point that was made about the ankylosis or the fusion of the body of the vertebrae was that it must take place in the presence of a mixed infection, rather than that of a tuberculosis. We did not find that fusion took place merely in the presence of a tuberculous abscess, but it is through the influence of a mixed infection that we find secondary deposits in these cases.

One fact was rather strikingly shown regarding the rapidity of fusion or ankylosis in the diseased area and that was that when mixed infection was present, bone deposit was much more active than in the purely tubercular cases.

Dr. W. S. Baer, Baltimore, Md.: I do not know that there is anything further that I can add to the Report of the Committee. I want to congratulate Dr. Calvé on the beautiful work that he has shown us. The whole matter seems to me to be boiled down to the fact that from the investigations that we have made, we should still keep the method of conservatism well before us. It does take a long time for a tuberculous process to fuse together, and that fusion of the bodies of the vertebrae has to take place before recovery entirely occurs. I can hardly agree with Dr. Rugh, if I understand him correctly, in the statement he makes that it is necessary for mixed infection to be present for fusion to take place in a tuberculous bone. I think, from an operative point of view, it is perfectly plain from the work of the Committee that you can get a fusion of the spinous processes in a

great majority of the cases either by graft or by means of fusion. By a fusion of the spinous processes, I do not mean a fusion of the body of the vertebrae, which we must get before a case of tuberculosis is going to be functionally cured. Therefore, the method proposed by Dr. Calvé, of a long period of recumbency, does give us a chance to get this fusion, although it takes a long period of time. The plan of the graft or fusion method itself does not prevent deformity. This still persists, not only in young children under four, but in 75% of the cases; and it does increase from five to fifteen years of age in 62 2-3% of the cases. It also increases in cases above sixteen years of age. I must say that in the cases we have seen, the general condition of the patient and the lack of symptoms seem to be better when the fusion operation was done than when we depend on the mechanical methods alone, such as are used in this country.

I think that we must draw the conclusion that simply an operation alone will not suffice to cure Pott's disease, and that we must keep up mechanical treatment until the bodies of the vertebrae becomes fused if we want to cure these cases.

FRACTURES OF THE FEMUR. END RESULTS.*

BY MELVIN S. HENDERSON, M.D.
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ROCHESTER, MINNESOTA.

My part in this symposium is to discuss the end results of fractures of the femur. In order to gain the proper perspective, I have reviewed the literature of the past five years and have carefully, with the assistance of Dr. J. I. Mitchell, studied the records of 222 consecutive cases in the Mayo Clinic. The literature on the subject is so abundant that I shall not attempt to discuss it, but proceed at once with the discussion of data concerning the patients who have been under our care.

Fifty-seven of the 222 patients had sustained fractures recently; the remaining 165 presented the end results of treatment which they had received elsewhere. These patients came to the Clinic because of malunion, delayed union, nonunion, chronic osteomyelitis, stiff joint, and so forth.

* Presented before the American Orthopedic Association, Boston, June, 1921.

RECENT FRACTURES.

Eighteen of the fifty-seven patients were under fifteen years of age. The data concerning patients who were not traced or under observation have been eliminated from the discussion, since the end results were too indefinite. There were three deaths. One patient died of a fractured skull the day of the accident, two died postoperatively, one of pulmonary fat embolism, the day of the operation, and one, a woman, aged 50, died in the third week from pulmonary embolism following reduction and treatment by the Whitman method of a fracture of the neck of the femur. Necropsy disclosed a huge pulmonary embolism evidently having its origin in a thrombosis in the common iliac vein. Thus remain definite records of forty patients from which to estimate end results.

Nine patients had sustained fractures of the neck of the femur; seven were cured. One fracture was of the intertrochanteric type, and a satisfactory result was obtained. One was a frank failure owing, I believe, to improper reduction of the fracture. One patient failed to carry out the treatment.

The Whitman method of treatment was preferred, but when for some reason it could not be carried out, the Ruth Maxwell traction and counter-traction method was employed, with a certain amount of abduction. Counter-traction, an essential part of this treatment, when properly applied, raises the trochanter and rotates the foot inward. It has been our practice, regardless of the type of fixation, to break down the impaction and set the fracture as one would any broken bone. On the whole, it is probably better routinely to break up a so-called impaction of a fractured hip except when for some reason, such as old age with debility, or a systemic terminal disease, such as pernicious anemia, malignancy, or tabes dorsalis, the treatment of the fracture must be carried along on palliative lines. There is no reason why a fracture of the neck of the femur, either of the subcapital or the intertrochanteric type, should fail to unite in persons in good health, and old age is not in itself unfavorable.

Seven patients had sustained fractures in the upper third of the femur; all obtained satisfactory results. Four were operated on and three were treated conservatively. Theoretically, owing to the slightly forward and outward displacement of the upper fragment, traction should be applied in a corresponding direction. The distance from

the symphysis pubis to the adductor tubercle on the inner condyle is increased by more than 2 cm. when the hip is in full abduction. The powerful adductor magnus must, therefore, be stretched correspondingly. I believe this is sufficient reason why traction should not be made in this manner. Lee has mentioned this recently. Straight extension is sufficient if properly applied and not used as a mere ritual.

There were fifteen fractures in the middle third of the femur, with fifteen cures. Ten patients were operated on and five were treated conservatively. A slight angulation will not so easily cause a static arthritis in this area as at either end of the bone. Sagging of the lower fragment posteriorly and laterally may occur, and care should be taken not to permit it to become too greatly displaced.

There were five fractures in the lower third, with three cures. One patient was operated on and four were treated conservatively. The lower fragment may become displaced posteriorly and the end press on the popliteal vessels and nerves. If the fracture is not readily reduced by manipulation, one should not hesitate to reduce it by operation, for if it is left but a short time, reduction even by the open method may be very difficult.

In children, the epiphysis may be separated and displaced forward There were three fractures of this type in the series, with two satisfactory results. One of the patients who died was a boy of nine, with an epiphyseal separation. He died the first day from pulmonary embolism. There were two open operations and one closed. It is astonishing how little deformity is evident in an epiphyseal separation with forward displacement, and it is not surprising that this somewhat unusual condition is often not recognized by the general practitioner Acute flexion of the knee, with traction and manipulation, may reduce the deformity. If the reduction is difficult and open operation is decided on, the split patellar incision gives excellent exposure and enables the surgeon to replace the epiphysis accurately. Personally, I have no hesitation in making a full exposure of the joint in this manner.

The problem of when to permit weight bearing is most important. The time varies with the type and location of the fracture and the age of the patient, but there should be a cardinal rule that patients with fractures of the femur should not be allowed to walk, when the time comes to permit weight bearing, without a Thomas caliper walking splint. The splint should be discarded only when the clinical and roentgen-ray examinations show firm union. I find that I am inclined

to lengthen the period of restricted weight bearing rather than to shorten it.

Of the forty patients, thirty-five (87.5 per cent.) were cured. Two had residual shortening and a consequent limp, and although they obtained excellent function, they are classified in the group of improved. The failures in the shaft were usually the result of bowing of the bones. This occurs even when the patient is wearing a cast. Some of the patients were permitted weight bearing without the walking caliper splint too soon, and some disregarded instructions.

Our practice now in treating recent fractures of the femur may be tersely described: The younger the patient, the easier is the application and the carrying out of conservative measures, although occasionally, even with babies, difficulty will be encountered in satisfactorily engaging the ends of the bone. When this occurs, open operation should be resorted to. In vigorous adults, under proper surroundings, the open operation, using beef-bone plates, or if necessary, metal plates, as internal fixation, in my experience at least, has been more satisfactory than conservative measures. In a well-equipped fracture ward in a hospital with trained attendants, conservative measures would, I believe, give equally good functional results, but such ideal conditions are rarely at hand. The proper internal splinting and postoperative fixation insures a perfect anatomic result. A good fracture table is essential; every hospital should have one. In elderly patients, I have been prone to resort to conservative measures, but in the future I believe I shall operate more often if patients are in good general health. This does not apply to patients with fractures of the neck of the femur, for which the Whitman abduction method gives perfect control of the fragments. Prolonged fixation in plaster tends to stiffen the knee and we are now putting joints in casts to permit early active motion of the knee.

OLD FRACTURES.

Of the 165 patients who came to us for consultation because of faulty end results, fifty had had fractures of the neck of the femur, and all but six of the fifty were operated upon. Five patients left our care too soon to show the end results. Thirty-nine of the traced patients were operated upon and twenty-eight (71.7 per cent.) were cured. In the successful cases, an autogenous bone transplant was used for nonunion in eight, beef-bone screws in eight, and metal screws or nails in four. Two patients had malunion, and osteotomy was performed.

In six, the union was delayed and plaster of Paris casts were applied. There were no deaths, although a patient operated upon recently, who was not included in the group, died three days after the operation because of cerebral embolism originating in a thrombosed common iliac vein. The thrombus passed through a patent foramen ovale, which had not caused symptoms during life. Plaster of Paris extending from the chest to the toes on the side involved, and to the knee on the opposite leg affords firm fixation. On the affected side a joint may be made in the cast at the knee so that the knee may be moved gently and stiffness be prevented.

I have not sufficient time to permit a free discussion of the type of case that should be selected for the pegging operation, and the type for the Brackett operation. I may say, however, that if absorption of the neck is practically complete and the head lies flush with the margin of the acetabulum, a bone pegging operation, no matter how carefully performed, is useless. Roentgenographs should always be taken with the foot in eversion and in inversion to show the amount of neck remaining. When a fair sized remnant of neck remains, I prefer to use the fibula as a transplant on account of its size and strength, but when there is little or no neck, I prefer the Brackett operation.

Transtrochanteric fractures and subtrochanteric fractures, as a rule, unite without any difficulty, but malunion may follow, necessitating an osteotomy. If the fragments are comminuted there may be excessive callus with some shortening, but strenuous attempts to obtain lengthening are not unattended with danger, for the muscles, nerves, vessels, and tendons may all be very much shortened. Even though there is considerable shortening, if union is firm, and the weight bearing line is satisfactory, it is my opinion that no interference should be undertaken.

In treating old fractures of the shaft of the femur, whether in the upper, middle, or lower third, the problem is much the same. An operation is difficult and may be attended with infection and risk to life. It is difficult to estimate end results in such patients because a study should be made of individual cases, and because in some it would be absolutely impossible to obtain perfect results. I have arbitrarily classified as cured patients in whom we have attained what I consider the maximum of benefit for the individual, thus making the classification a personal equation. Therefore, a discussion of some of the interesting facts I have elicited in the scrutiny and study of the histories of these patients may possibly be of more value than an attempt to tabulate results.

I was very much impressed by the fact that it is an extremely difficult matter to keep the records of patients who are under observation for some time in a manner so that an intelligent and comprehensive résumé of the patient's progress from the time he enters the hospital until he is dismissed cured, improved, unimproved, or still under observation, can be made. An editorial in the March issue of the *Journal of Orthopædic Surgery*, on the subject of reporting results in fractures, briefly states what such a report should be. But few of us can really offer such valuable data.

The metal plate was used in fifty-eight operations. In this day of autogenous bone grafting this seems rank heresy, but I must confess that in many of these old fractures of the femur, after I have made a tediously long dissection to expose the fragments, freshen them, and fit the ends, I am only too glad to fall back on the metal plates and screws as the easiest and quickest way out of a difficult position. Prolongation of the operation to apply a bone graft is attended with a risk that cannot be lightly considered. The oblique and spiral fractures may often be easily held with beef-bone screws alone, and in the transverse fractures the beef-bone plate and screws combined are in many respects ideal. Sepsis is more prone to follow the use of the metal plates than the use of the beef-bone plate or autogenous bone graft. It is now my practice to remove every metal plate as soon as union is sufficiently firm to permit its discontinuance. Infection may spoil a well conducted operation, and is a factor to be considered in dealing with end results. In the present series infection ran high and occasionally caused failure. We have classified as infections all cases in which pus discharged, regardless of whether or not it influenced the convalescence. Twenty per cent. of the clean cases became infected. In the cases in which operations had previously been performed (in many, infection had followed the primary operation), 43 per cent. developed infection afterward. I do not believe this to be the fault of our technic, but rather the type of case, for in a recent investigation of 413 autogenous bone grafts, in 247 operations for ununited fractures, infection developed in 10 per cent of the clean cases, and in 41.3 per cent. of the previously infected cases there was a discharge of pus. In the easily conducted 166 spinal transplants of the series, however, only 2.6 per cent. became infected, in spite of the fact that two large incisions were made and the motor saw employed in each case. Under a system of close checking up on the postoperative condition of wounds following general surgical operations in the Mayo Clinic,

Sistrunk finds that almost 10 per cent. of the clean cases show some degree of infection.

Whatever the means taken to hold the fragments in position, some form of postoperative fixation is essential. There are two ways to secure this: one is fixation in a cast, and the other is some form of extension. I have no hesitation in saying that to rely on the cast to hold the fragments in place in a fracture of the shaft of the femur, either recent or old, when there is any tension of the muscles and tendons, is to court disaster. Bowing may occur no matter how carefully a cast is applied, particularly if it is put on under extension on a fracture table. The only safe way is to put the patient in bed with enough extension to overcome the spasm of the powerful muscles. I prefer to apply a light cast to the thigh and a Thomas splint, elevate the foot of the bed and by a combination of weights strung over a pulley and the patient's own weight, maintain extension until the fracture is firmly enough united so that either a cast or a walking caliper may be used. In the majority of instances adults should not be permitted full weight bearing for six months following operative measures.

There were 115 fractures of the shaft of the femur. Twenty-four were in the upper third; fifty-seven in the middle third, and thirty-four in the lower third. Ninety-eight patients were traced, seventeen were not traced. Sixty-nine were operated upon by some form of open operation. In this list are the nonunions, malunions and delayed unions, with fifty-three (76.7 per cent.) satisfactory results. Twenty-nine patients were treated by conservative measures with twenty-seven (93.1 per cent.) satisfactory results. The nonoperative treatment gave a greater number of proportionately good results than the operative treatment. It must be remembered, however, that operative measures were employed for the more serious fractures, while nonoperative measures, such as manipulations under ether to line up the fragments, and treatment by extension and Thomas splints, were employed for the more simple fractures.

It is not possible to deduce the best method by statistics, but I believe that in fractures of the neck of the femur, if enough of the neck remains, the bone peg, preferably the fibula, is the method of choice, but if the neck is absorbed, the Brackett operation offers the most encouragement. In the shaft, theoretically, the bone graft, either the intramedullary, inlay, or massive, is preferable, but for practical reasons the metal plate must often be used. The beef-bone plate is supplanting the metal plate in our practice, and I believe is much better tolerated by the tissues.

One hundred and two operations were performed for old fractures with two deaths. One woman, aged 38, with nonunion of the middle third of the femur, died the day of the operation from pulmonary embolism; necropsy was not permitted. One patient, a man aged 32, died the sixth day after operation, and necropsy failed to disclose adequate cause for death. A slight broncho-pneumonia and a slightly contracted kidney were found, but no evidence of pulmonary embolism. I am inclined to believe the patient died of renal insufficiency, although clinical examination had been negative.

There are two serious complications that are of clinical significance and which stand out in this review. First, thrombosis of the common iliac artery in fractures of the neck of the femur. This is, I believe, more common than we have thought. It was demonstrated at necropsy in two of our patients dying of embolism, and probably was the cause of the persistent edema seen in some of our patients, who, as far as the fracture was concerned, obtained excellent results. Second, dilatation of the stomach. This occurs but rarely in orthopædic cases, but if it is unrecognized, may cause the death of the patient. I have often heard Dr. C. H. Mayo say that if in the surgical wards of hospitals the internes carried stomach tubes hanging about their necks instead of stethoscopes, the mortality rate would be reduced.

SUMMARY.

Fifty-five of the fractures were recent; nine were in the neck of the femur, and seven were cured. The two failures were owing, in one instance, undoubtedly to improper reduction, and in the other to the removal of the cast in three weeks and the patient's refusal of further treatment. Forty patients were observed to end results; thirty-five (87.5) had obtained entirely satisfactory results. Although I am not prepared to state, from such a small series of cases, whether open operation or conservative measures is the preferred treatment, I do not hesitate to operate on patients, providing conditions are satisfactory, if I am satisfied that the fragments are not in good position.

One hundred sixty-five of the fractures were old, or end results of fractures of the femur. It is difficult to judge the conditions under which the primary treatment was carried out, but it was undoubtedly quite inefficient in the greater number of cases. In the smaller number, union had been slow and the pull of the powerful muscles, or too early weight bearing had caused bowing. It is difficult to determine from the roentgenograms or from clinical examinations when union is

complete in a case of malunion. On opening some of the fractures of this type, motion was easily demonstrated. In fifty patients, the causes of the disability were faulty end results following fractures of the neck of the femur. Five patients were not traced and six were not operated on by the open method; the remaining thirty-nine were operated on. Osteotomy for malunion was performed in two; the others were treated for non union, and twenty-eight (71.7 per cent.) were cured. In cases in which the neck was absorbed and union was attempted by using a bone peg, failures were uniform. A fair amount of neck must remain if there is to be any chance of union. The Brackett operation is the method of choice when the neck is destroyed.

One hundred fifteen patients with fractures of the shaft were treated and ninety-eight were traced. Sixty-nine were operated on and 76.7 per cent. were cured. Twenty-nine were treated by conservative measures, and twenty-seven (93.1 per cent.) obtained satisfactory results.

End Results in Fractures of the Femur, 222 Cases.
57 Recent Fractures; 165 Old Fractures.

40 patients with recent fractures traced, 35 (87.5%) cured
10 fractures were of the neck, 8 were cured 7 fractures were of the upper third, 7 were cured 15 fractures were of the middle third, 15 were cured 5 fractures were of the lower third, 3 were cured 3 were separations of the epiphysis, 2 were cured.
2 postoperative deaths, both due to pulmonary embolism
143 patients with old fractures were traced
50 fractures were of the neck 39 were operated on, 28 (71.1%) were cured 6 were manipulated and casts applied, 6 were cured 5 patients were not traced
115 fractures were of the shaft 69 were operated on, 53 (76.7%) were cured 29 were not operated on, 27 (93.1%) were cured 17 patients were not traced.

THE TREATMENT OF FRACTURES OF THE FEMUR.

BY FRANK E. PECKHAM, M.D., PROVIDENCE, R. I.

In the treatment of fresh fractures of the femur, the mechanical principles involved are very simple, and right here it might be said that all treatment should be reduced to simplicity, which is directly away from much of the complexity which is seen in medical print in these post-bellum days.

In a fresh fracture of the femur, anywhere from top to bottom, traction and counter-traction will pull the leg down to length.

In Figure 1 (a), is illustrated a patient with extension and counter-extension applied. The extension is applied as usual, with wide adhesive straps on the sides of the leg from a point just *above* the level of the fracture. A part of the counter-extension is obtained by elevating the foot of the bed, but this is not sufficient. To obtain a sufficient amount of counter-extension a long, padded, peroneal band is adjusted on the side of the fractured leg and a pulley at the head of the bed is used for the weight. About one-half of the amount of weight on the leg is used as the counter-extension at the head of the bed. Judgment is used as to the amount of weights necessary in the individual case, depending on whether there is much or little riding by of the fragments. The constant, never-let-up traction, hour after hour, pulls the fragments down to length. The position of the fragments is established by x-ray pictures so that it is possible to gauge the position accurately. In all fractures of the shaft, the foot should be kept not only at a right angle, but in the upright position. In all fractures of the middle and upper third coaptation splints are used. They should extend the whole length of the femur. Posteriorly, sometimes, not always, a "ham splint" or a posterior wire splint is made use of.

Now and then, after a leg has been pulled down to length, the fragments refuse to go into apposition. This may be overcome by a mechanical device if the sharp ends are not caught in the soft tissues. If they are caught, then surgery is necessary, but ordinarily it is not the surgery of internal fixation. A comminuted fracture of the lower third will illustrate this condition. The fragments sagged downward when the extension and counter-extension pulled the leg down to

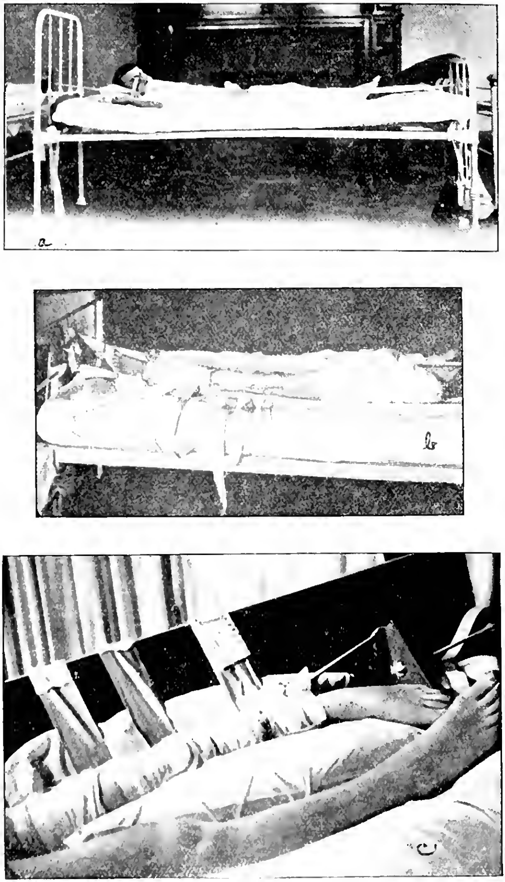


Fig. 1.—(*a*) Shows a patient in bed with extension and counter-extension applied. (*b*) Illustrates how the incision is made with the patient in bed and with extension and counter-extension in force. (*c*) Shows how the wide T splint is used in connection with the adhesive straps to produce strong internal rotation in fractures of the neck of the femur, after the leg has been pulled down to longer than "length" as proved by the x-ray.

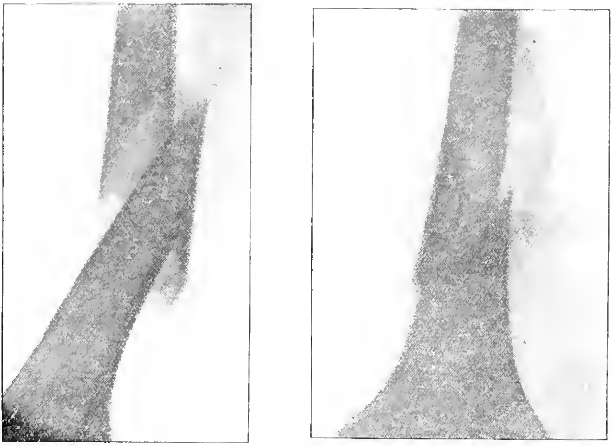


Fig. 2.—Shows fracture of lower third taken before treatment and after union had taken place.

Fig. 3*a*.—Shows the fresh fracture.

Fig. 3*b*.—The mechanics for elevation.

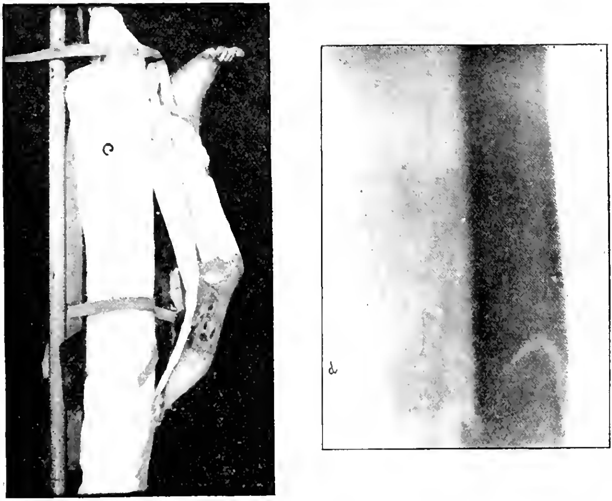


FIG. 3.—(c) The leg in place with proper elevation. Also shows healed incision. (d) Shows apposition of fragments.

FIG. 4.—Shows a fresh fracture of the middle of the femur with the same bone after strong union had taken place.

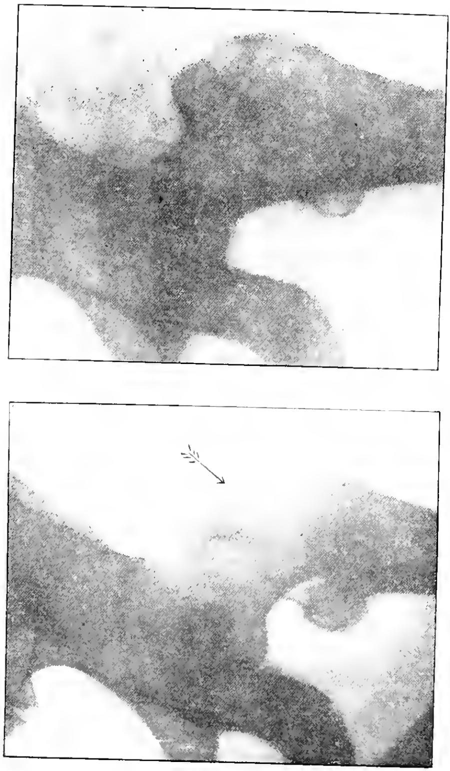


FIG. 5.—Fracture of the neck of the femur before and after reduction.

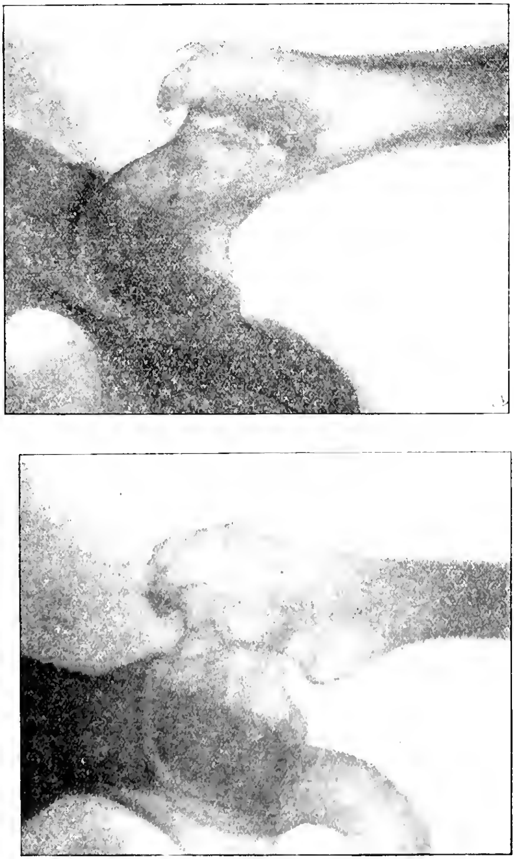


FIG. 6.—(*a*) The fresh fracture. (*b*) After setting.

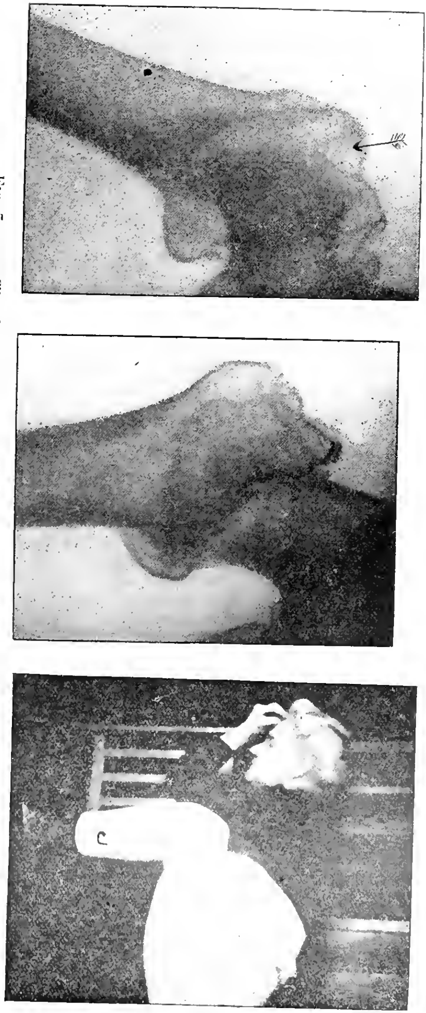


Fig. 7.—(a) The fresh fracture. (b) Twelve weeks after the accident. (c) Possible flexion one year after.

FIG. 8. (a) Shows a fresh fracture of the middle of the neck of the femur. (b) The fracture one year later. (c) Shows the possible flexion one year after the accident.

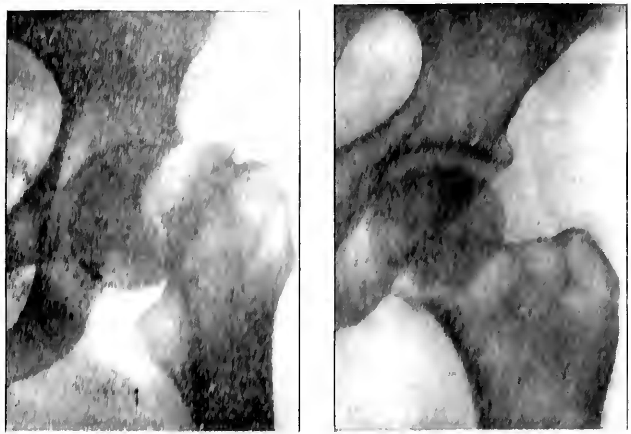


FIG. 9.—Shows a fresh fracture of the middle of the neck of the femur before and after reduction. The long fragment pulled down well under the small round short fragment.

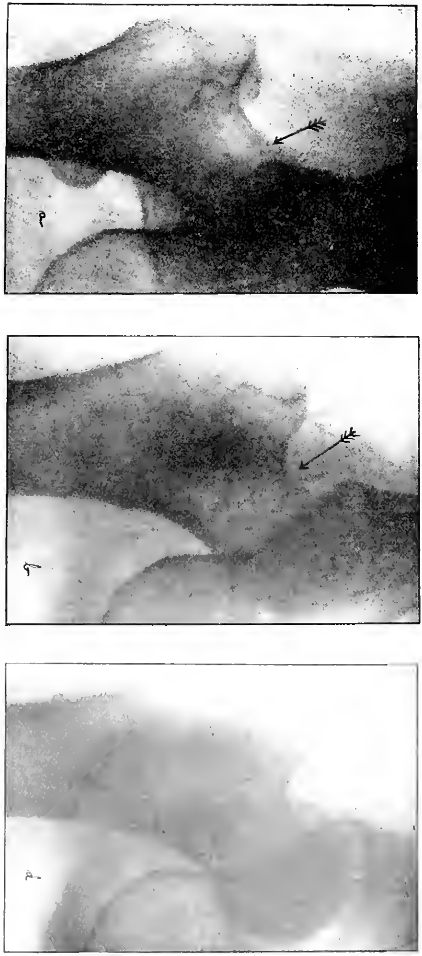


FIG. 10.—(*a*) Shows the fresh fracture. (*b*) Shows the leg pulled down to a little longer than "length." (*d*) Shows the bone one year after the accident.

length so that they were not in apposition. In this case, a folded sheet under the point of fracture gave sufficient elevation to completely restore the alignment.

Figure 2 shows the fracture before treatment and after union had taken place.

Figure 3 (a). This fracture was pulled down by extension and counter-extension, but apposition was impossible. It was apparent that one or both fragments had caught in the muscle tissue. Here was a case for surgery, but not the internal fixation kind of surgery.

A curved splint, Figure 3 (b), was arranged underneath the leg. This splint could be raised and lowered as required. A sufficient amount of elevation was given until the x-ray picture showed the bone in a straight line but still not in apposition. The patient was then taken to the operating room in bed, with the extension and counter-extension all intact. Also the leg was on the splint as shown in Figure 3 (c). Under ether, an incision was made on the outer side of the leg at the seat of fracture. The short fragment was found stuck in the soft structures. After it was disengaged, the fragments easily went into apposition, Figure 3 (d). The mechanics, the patient, the leg, nothing was disturbed from its fixed position either by ether or the operation. The wound was closed and union was uninterrupted.

Figure 3 (e) shows the healed incision the day the stitches were removed.

Figure 3 (d) shows the apposition of the fragments.

Cases of simple fracture of the middle of the femur reduced by extension and counter-extension have been shown in former papers before this Society, so that only one case will be published where extension and counter-extension pulled the leg down to length but the ends still remained separated. The pulls were arranged as in Figure 1 (a) and (b), and the patient sent to the operating room in bed with the various extensions intact. Under ether, incision was made as illustrated in Figure 1 (b). The fragments were found caught in the soft structures. When they were disengaged, the ends went into contact in fairly good apposition. The wound was closed, the mechanics not having been disturbed in any way. The treatment in this way was reduced to that of a simple fracture again. The surgery was entirely secondary to the mechanical treatment, no internal fixation being necessary.

Figure 4 shows the fracture before treatment and after union had taken place and the boy walking on it. In very oblique fractures the

ends may be so shaped that one end will dovetail into the other, thus holding firmly without any internal fixation.

In fractures of the neck of the femur, extension and counter-extension are also used to get the leg not only down to length but just a little *longer*, as will be shown in the actual cases. The time required may be only two or three days in some of the easy cases, or may require ten days or two weeks in others. Not later than two weeks, the fragments must be in perfect apposition. After the leg is down to a little longer than length, as actually demonstrated by x-ray pictures, perfect apposition is obtained by strong internal rotation. This is accomplished as illustrated in Figure 1 (c). A T splint is placed in position extending from the axilla to the foot of the bed, so that it is well fixed in position. This T splint is quite wide, so that it extends well above the level of the leg. Then the adhesive straps, usually three, are placed around the leg in such a manner that when brought up over the wide T splint they strongly internally rotate the leg. This brings the fragments into absolute contact and exactly end to end. This must also be absolutely demonstrated by the x-ray and the mechanics "played with" until the contact is perfect.

A few cases will suffice to show the results of such mechanics if properly applied.

Mrs. G. Age, 48. Figure 5 (a)—The fresh fracture. Figure 5 (b) —The fracture after setting. Observe the way the leg is pulled down to longer than "length" and the excellent "valgus" angle of the neck with the shaft.

Mrs. McG. Age, 42. Figure 6 (a)—Shows the fresh fracture. Figure 6 (b)—The fracture after setting. Observe the "valgus" angle of the neck with the shaft.

Mrs. S. Age, 64. Figure 7 (a)—Shows the fresh fracture. Figure 7 (b)—The fracture twelve weeks afterwards. Observe the "valgus" angle of the neck with the shaft. Figure 7 (c)—Shows the possible flexion one year after the accident.

Mrs. C. Age, about 50. Figure 8 (a)—Shows a fresh fracture of the middle of the neck of the femur. Figure 8 (b)—The same fracture one year later. Observe that the leg was pulled down so that the long fragment was *under* the short fragment, which amounts to a round ball of bone in some cases. Figure 8 (c)—Shows the possible flexion one year after the accident.

Miss R. Age, 70. Figure 9 (a)—Shows a fresh fracture of the middle of the neck of the femur. Figure 9 (b)—Shows the reduction

with the long fragment pulled down so that it is decidedly *under* the small, round, short fragment.

Mrs. C. Figure 10 (a)—Shows a fresh fracture of the middle of the neck of the femur. Figure 10 (b)—Shows the leg pulled down to a little *longer* than "langth," with the bone well *under* the short, round fragment. Figure 10 (d)—Shows the bone one year after the accident.

Having the long fragment in these cases pulled well down, so that it is not on the level with but well *under* the short, round fragment, has been emphasized in this paper. It is important because when union has taken place, the body weight pushing downward does not make so much a cross strain but more in the longitudinal direction of the bone. This position is insurance against shortening which may take place even with seemingly good union, if the neck is in a "varus" position. I cannot find that this point in the mechanics has been previously mentioned in literature.

With this method of treatment the whole thing is done gradually. Neither ether nor plaster of Paris is necessary. Every square inch of the body may be bathed and cared for. If necessity arises, the patient may be bolstered up in bed 45 or 50 degrees. A lady 75 years of age has just been successfully taken through this treatment while up in bed at an angle of about 60 degrees. The union as shown by the x-ray is perfect and she is beginning to walk on the leg.

This case may be matched up with another lady, aged 75, where there was no callus formation whatever. It was very interesting though to observe with what ease the fragments could be kept in perfect position for weeks (proved by frequent x-rays) without any union.

Another patient, around 70 (?) years of age, after there was beginning union, took off all apparatus and was found sitting in a chair when the House Officer appeared on his morning rounds. This was the first patient, however, to do this, but I have had two cases within a year (including the one above mentioned) of no callus formation whatever. There was one other case where union was delayed until about four months, but finally it was all right.

Regarding the so-called setting or getting the fragments into perfect apposition, so far, it has *always* been possible to do it in the way described and illustrated.

Trouble could only arise from calcium deficiency causing delayed union, or entire lack of union, and, as in the one case mentioned, a refractory patient.

END-RESUTS IN FRACTURES OF THE KNEE AND ANKLE.

BY DR. G. W. HAWLEY, BRIDGEPORT, CONN.

THE English writer, Chesterton, has recently said that facts are one thing, but the truth quite another. It is easy to assemble facts, but it is difficult to extract the principles of truth. This is true of the end-results of surgical treatment because of the present limitations of surgical therapeutics and because reports deal with the known and not the unknown facts. Sir Berkeley Moynihan puts it very clearly when he says that the surgical ritual begins with the early treatment but does not end until the patient is restored to health. In most surgical institutions the ritual of treatment ends with the anatomical, not the functional recovery, and most hospitals are better informed regarding results when the patient leaves the hospital and not with the final return of the patient to health. The era of abdominal surgery of the last twenty-five years with its record of achievement, accounts in part for the incompleteness of surgical treatment, because it has been chiefly absorbed in the perfection of surgical technique and the development of the ritual of operations. Moreover, surgical treatment has been based on anatomy, and operations have been performed to correct form only. This has been true of fracture surgery. The worship of form is natural, because defect of form is obvious. It is easier to ascribe disability to defect of form, than to prove it, and it is easier to treat deformity than disability. Today, surgery is assuming more and more of a biological basis, and treatment is being carried out, consciously and unconsciously, on the scientific study of the relation of deformity to disability. No longer are operations systematically undertaken to correct architectural defects alone, and the history of pelvic surgery is suggestive of the future.

So far, the statistics published regarding fracture results represent but a small fraction of all the fractures occurring every year. The text-books offer little information, and the efforts of the fracture commissions of the British Medical Association and the American Surgical Association have not produced reports sufficiently complete to be conclusive.

The determination of fracture results is difficult because, unlike abdominal and other branches of surgery, there is no standard system of treatment, no standard interpretation of the principles of treatment, no standard measure of the function of a limb as a motor and no

standard measure of the effect of the fracture deformity on function.

It is not the purpose of this paper to present an imperfect report of cases covering a long period. Instead, I have taken the liberty of confining this report to cases treated during the last two years, in which the treatment has been carried out and the results measured according to a definite code, however imperfect that code may be.

The remark is frequently made that this is an age of change, and someone has added that change is the only unchanging thing in the world after all. In the treatment of more than six thousand fractures during the last fifteen years, exclusive of war fractures, my views regarding fracture treatment have undergone gradual change and these changes must be taken into consideration in the report of the cases herewith submitted. In order to explain these changes, it will be necessary for me to define in some detail the code which I have attempted to formulate as a guide to the treatment of any and all fractures. I trust I may be pardoned for repeating many time-honored and obvious truths.

1. The treatment of a fracture is not the treatment of a broken bone, but of a motor with a broken part.

2. Restoration of function is more important than restoration of form.

3. The treatment of a fracture is the treatment of a disability, not deformity.

4. The treatment of a fracture as a deformity only is a sterile ritual of form. If it were not for the fact that deformity often causes disability there would be no reason to correct deformity except for appearance only.

5. The treatment of a fracture deformity, except for cosmetic effect, depends upon the relation of the deformity to disability, for there are deformities without disability and slight deformities with great disability.

6. By reduction is meant the correction of a fracture deformity, when a deformity requiring correction exists.

7. By immobilization is meant the immobilization of the broken ends of a bone, not the motor apparatus. Immobilization has but one purpose, the prevention of deformity, and it is always imperfect, never complete. All fractures, treated and untreated, consolidate, and those ununited after five or ten years are the rare exceptions which prove the rule. Immobilization is unphysiological except when strictly limited to the pathological necessity, and the necessity in fracture is very different from the necessity in tuberculosis. Immobilization is an un-

fortunate necessity in fractures because of the technical difficulties of securing necessary fixation of the broken part without unnecessary fixation of much or all of the injured motor. Immobilization of the motor apparatus inflicts temporary or permanent damage. It is easily overdone and made an empirical formality because of the imperfect methods of fixation and because of the difficulty of determining when the necessity exists and when it ends.

8. By mobilization is not meant mobilization of broken bone ends, but mobilization of the motor apparatus. Lucas-Championière was right in insisting on the value of mobilization, but the distinction must be made between avoidable and unavoidable deformities and those with and without disability. There is no conflict between the so-called mobilization and immobilization treatment. The two go hand in hand, and improvement in fracture treatment depends very much on the development of methods which effectively combine mobilization of the motor and fixation of the fracture.

9. The term manipulation is a term of disguise unless defined in definite physiological terms. Otherwise, it has the same unscientific meaning given it by old-fashioned and the modern bone-setters.

10. There are only two forces, traction and leverage, which may be utilized to correct fracture displacement. Of these, traction is the force most effective in the reduction of fractures of the long bones where the two pieces possess length, and leverage of the fractures when one fragment is long and the other short.

11. The mechanical treatment of fractures is not a mechanical, but a physiological problem. The skeleton is not a piece of stationary furniture on which to apply the ancient art of cabinet making, nor is it an internal combustion engine. It is a self-repairing machine whose powers of repair are little understood.

12. The treatment of fractures as a physiological problem involves the study of an arm or leg as a motor, the study of fracture deformity and its relation to disability, the study of the correction of deformity, the study of fracture repair, the study of motor repair, and the study of permanent disability.

13. The treatment of an injured limb necessitates an understanding of the operation of the limb as a machine. It takes years to develop ordinary function and special training to develop specialized function, as every skilled artisan knows, but it takes little time and little damage to impair for a longer or shorter period what has taken a long time to acquire. The action of individual muscles and joints has been described, but this does not explain the operation of the hand

of an engraver or the potential biological weakness of the shoulder as a motor.

14. The intelligent treatment of fractures depends on the scientific application of the relationship of deformity to disability, for it is unscientific to employ the same efforts to correct a non-disabling, as a disabling deformity. Some day the surgeon and the layman may substitute the worship of function for the worship of form, and acknowledge that an architectural defect in a bone, unless unsightly, is of no more importance than similar defects of other organs, provided it functions properly. The word shortening loses its terrifying meaning unless accompanied with disability.

15. The correction of fracture deformity and the fixation of corrected deformity involves the use of force, posture, and apparatus, but to use mechanical methods in a machine-like way, to apply plaster as a matter of form, to employ traction with no standard of form, or test of efficiency, it not good surgical practice. Too often is the test made on appearance only, just as the aeroplane splint is used without the appreciation of the imperfect control, and the resulting rotation deformity, of the scapula.

16. The process of fracture repair is a nutritional problem, localized in the damaged bone. Nature is extravagant in the normal and pathological calcium flux, and excessive deposit is the rule in bone injury and bone disease. Fractures consolidate in the presence of constitutional disease and in presence of local bone disease quite in the ordinary way. Surgical fractures in rickets and pathological fractures in carcinoma and tabes are no exceptions, and the same is probably true of fractures in lues. Fracture repair, whether hastened or delayed, depends on the revascularization of the injured bone and this in turn depends on the damage to the nutrient end-artery, the periosteum which acts as a vascular bridge for the countless vessels which pass from the soft parts to the bone, and the supply of the nutritional fluid to the limb. Delayed repair is due primarily to delayed revascularization

17. Motor repair involves the study of the pathological as well as the normal function of muscles. When a bone is fractured normal function ceases and the pathological function begins. So-called muscle balance does not exist in the pathological state where individual muscles assume the power of permanent contraction. Motor repair involves the control of pathological function and the reëstablishment of normal function. The control of pathological function is graphically described by Sir Robert Jones when he says that the splinting prop-

city of muscles is abolished when the artificial surgical substitute is sufficient to relieve nature of the necessity of splinting, and only then. This provides an accurate test of the efficiency of artificial splinting. When traction is inefficient pathological function continues, but when efficient the muscles automatically relax into the state of normal rest. The early or the late reëstablishment of normal function indicates the difference between the preservation and the restoration of function.

18. The study of established fracture disability involves a determination of the functional capacity of the damaged motor and the relation of structural change to functional loss. Measurements of length and range of motion mean little to the skilled workman. It is very much the same to such a man after long immobilization of the leg for fracture, as if the motor tract between his brain and leg had been cut. He is like a child learning to walk and he does not need to be told the definition of the term reëducation. Something more than the tests of primitive motion is needed and the distinction should be made between ordinary and specialized function. The surgeon is not always the best judge of surgical treatment. The best judge of the repair of a machine is not the man who does the work but the owner who drives the machine.

19. The term reconstruction treatment is used to include both the restoration of form and the restoration of function. It would be better if the two were more clearly defined because function may be preserved or restored but it cannot be reconstructed. The term came to life during the war, but no one who has seen anything of war fractures is blind to the fact that if early constructive treatment had been possible, most of the late reconstructive treatment would be unnecessary. If the war has taught anything, it has taught that reconstructive treatment should be used to prevent, rather than correct, disability.

20. Active motion is the most effective agent to preserve function and promote repair. All others are auxiliary agents. Active motion is the only means of preserving the combined and organized motor-nerve-group-muscle action. Every machine must run on its own power and no substitute can take its place. The application of active motion in an injured motor is not a simple problem. To direct a patient to move his limb accomplishes little. This explains in part the frequent failure of the application of the Willems' treatment of septic joints. There is a great difference between active motion under pathological, and under normal conditions. In every injured limb the pathological state establishes limitations of physiological action and the

appreciation of the limitations imposed is the guide to the application of active motion. This must be carried out within the pathological limitations, which are frequently narrow, but to ignore these limitations is to invite defeat through the automatic inhibitory control, and this control is absolute. The object of active motion is not mechanical but physiological, and a little motion produces the desired effect. This is often difficult unless passive motion is used to assist active motion and the active motion is gravity-free. Fracture consolidation is hastened by active motion, and the natural powers of fracture repair have not yet been fully tested.

21. Massage and passive motion, or their mechanical equivalents, are poor artificial substitutes, but valuable contributing agents, when used to aid or coach active motion. Passive motion alone is unphysiological, because it reverses joint leverage and muscle action. One machine operates the other backwards and without much benefit to either. Passive motion alone establishes a combat because one machine opposes the other, and it is only necessary to inflict pain to intensify the opposition. Passive motion has but one object, joint motion, and this it accomplishes against physiological and psychological odds. Only when used in conjunction with active motion is this antagonism overcome and it is more naturally overcome when passive motion is carried out by the patient.

Massage is a valuable agent when it is done by one trained in the sick room and not in a gymnasium, but it is feeble in comparison with active motion to prevent agglutination of gliding surfaces, preserve elasticity, remove exudate, and promote repair. The active contraction of muscles is one of the best methods of drainage and without the auxiliary booster or pump action of the muscles the flow of the nutritional fluid in a limb is always deficient.

The cases herewith reported include 19 fractures of the knee and 38 of the ankle. Of the 19 knee cases, 10 are fractures of the patella, three of the femur and six of the tibia. The ankle cases include one epiphyseal fracture with deformity, four fractures of the posterior angle of the tibia, four Pott's fracture with posterior dislocation of the astragalus, 12 with lateral displacement, and 17 without displacement.

SUMMARY OF CASES.

Of the ten patella fractures all were submitted to operation on the first to the fourth day. Immobilization of the fracture was secured by wire. There was no external splinting. Active motion (gravity-free) assisted by passive motion was begun on the fourth day. Walk-

ing was begun on the eighth day with the aid of a cane only. Ninety degrees of active motion was obtained in eight to fifteen days. Two subjects returned to work in four weeks, six in five to eight weeks, and two in ten weeks.

Of the fractures of the femur extending into the knee-joint, two were oblique fractures of the internal condyle with little displacement and one a T fracture of the condyles with telescoping of the shaft of the femur downward. The former were given hammock suspension in a Thomas splint without traction and massage with gravity-free active motion for six weeks, followed by gradual weight-bearing and full motion and power in ten weeks. In the other case, partial correction of the extensive fracture displacement was obtained by the use of the Watkin-Williams calipers in a Thomas splint with a Pearson leg-piece. Active motion throughout treatment. Operation for removal of projecting femoral shaft just above patella after four weeks, and weight-bearing after sixth week. Full recovery and return to work as steeple-jack eight months after injury.

The six fractures of the head of the tibia included four of the inner tuberosity, a V fracture involving both tuberosities, and one spiral fracture of the upper shaft with fissures through the joint surface. In all but the last there was little architectural deformity and hammock suspension combined with active motion was employed, and weight-bearing begun at the end of the fourth week. In three of these cases there was complete recovery with restoration of motion and function in eight to ten weeks. In two subjects over sixty years of age with preëxisting osteoarthritis there was limitation of motion and considerable loss of function.

In the case of the epiphyseal separation of the lower end of the tibia there was wide lateral displacement of the lower fragment with an oblique fracture of the inferior end of the shaft. This deformity was completely corrected without difficulty and the leg immobilized in a Delbet plate splint which allows mobilization of the knee and ankle. Active motion of the leg muscles and joints throughout treatment. Immobilization removed at the end of two weeks. Recovery with preservation of joint motion and motor power in six weeks.

Of the four fractures of the postero-inferior angle of the tibia there was marked upward displacement of the lesser fragment with the body of the astragalus in all. In two cases complete restoration of the normal joint architecture was secured after the method of Sir Percival Pott with the patient under a general anesthetic and the foot and ankle immobilized in plaster with the gastrocnemius tendon fully

stretched. The plaster was removed in two weeks, when active motion with the auxiliary agents was instituted followed by weight-bearing after four weeks. Recovery in one case in six weeks and incomplete recovery in the case of an obese woman fifty-six years of age, with pre-existing flat feet and chronic nephritis with oedema.

In the two other of the Cotton type of fracture in which slight deformity is associated with marked secondary disability, all attempts at external correction failed and the correction of the joint architecture was accomplished by nailing the small fragment in place through a posterior incision with no external immobilization. Active motion was started on the fourth day and weight-bearing at the end of three weeks. Complete recovery in one case in five weeks and the other nine weeks.

The four cases of Pott's fracture with complete backward displacement of the astragalus were reduced after Pott's original procedure with the knee flexed on the abdomen and the gastrocnemius muscle fully relaxed, followed by immobilization in Delbet plaster splints and the foot held in dorsal flexion by a loop of muslin bandage. Active motion of ankle-joint and leg muscles by temporary release of the muslin loop carried out from the beginning. Immobilization removed in two weeks. Foot held in abduction by adhesive straps. Weight-bearing end of three weeks. Recovery in one case in four weeks, in two six weeks, and incomplete recovery in man of sixty-nine years, with moderate widening of the ankle mortise.

Of the twelve Pott's fractures with frank widening of the mortise of the ankle all were immobilized in Delbet plaster splints with the leg in the Pott's position and no attempt made to treat the deformity or the fracture, but the disability. The Delbet splints were carefully moulded to hold the mortise tight, with pressure made on the outer side of the os calcis to hold the astragalus from displacement outward. Dorsal flexion at the foot and active motion carried out as described above. Plaster removed on the eighth, tenth or fourteenth day. Recovery in eight cases three to four weeks, in three cases six to eight weeks, with moderate disability continuing in one.

Of the seventeen cases of fracture of the lower end of the fibula without rupture of the inferior tibio-fibular ligament and with the mortise tight, but potentially weakened, artificial lateral ligaments by means of three-ply adhesive straps applied on each side of the leg with the foot adducted were used and active motion with massage and weight-bearing, carried out throughout the treatment. Full recovery in three to six weeks.

THE TREATMENT OF SPRAIN-FRACTURE OF THE TUBERCLE OF THE TIBIA IN ADOLESCENCE (OSGOOD-SCHLATTER DISEASE).

BY DR. ROBERT E. SOULE, NEWARK, N. J.

THE purpose of this paper is to record a method of treatment for fracture sprain of the adolescent tibial tubercle which in my experience has proved most satisfactory.

With our present-day aids to diagnosis there should be no difficulty in the differentiation of this lesion from other affections of the knee joint. Usually there is a definite history of trauma, either direct or indirect, through striking the knee or through a sudden violent strain of the quadriceps muscle, such force causing the separation of fibres of the patellar tendon at its attachment to the upper diaphysis of the tibia and the tibial tubercle, which in adolescence is usually a beak-like projection from the upper epiphysis, overlapping the upper end of diaphysis in its anterior portion, and is separated from the diaphysis by cartilage.

The direct fibres of the patellar ligament are attached to this beak-like projection of the epiphysis, and, in addition, radiating tendon fibres are traced in a fan shaped distribution to either side attached to the tibial diaphysis. From this fan shaped distribution of the patellar tendon fibres it can be understood why the force applied does not produce a total inability of extension of the injured leg. In all cases there is some power of extension following such an injury, though this ability is greatly reduced and painful. This maintenance of partial ability to extend the leg following this injury is attributed to the remaining unruptured tendon fibres or to the sprain or partial fracture of this tibial beak only.

The local swelling is attributed to the increase of bursal fluid set up by the trauma to the bursa lying between the ligament and the tubercle, plus the infiltration resulting from the tearing of ligament fibres and direct tissue damage. One should not be misled in examining roentgenograms of both knees showing what at first glance would appear to be a like condition of both tibiae. A closer examination will show the thickened overlying soft parts and most frequently small shadows of bone density separated from the beak, also a hollow in the anterior surface of the beak, believed to be the bed from which the particles of bone have become separated. It is possible to have the same disability in both knees. Such a case came under my observation.

A boy about 13 years of age, while holding to the rear of a horse-drawn sled and sliding along on his shoes over the slippery road, allowed his feet to reach too far under the rear of the sled so that in his attempt to recover control his knees caught under the body of the sled, severely tramatizing both knees. I saw him several months after the accident and noted the enlargements over both tibial tubercles, and although he had great difficulty in going up and down stairs, he could walk fairly well on a level surface and some local tenderness was complained of in both knees.

Another case, a girl of 13 years of age, while at school fell and injured her knee. This case came under my observation shortly after the injury. Appropriate strapping was applied and the leg and thigh held in extension in a plaster of Paris cast, followed by massage and graduated mobility of the knee after a reasonable period following cessation of acute symptoms. The partial disability and some local tenderness persisted after several months' time, when the case passed from my observation, which disability might persist permanently or until final union of the tubercle and tibia would take place.

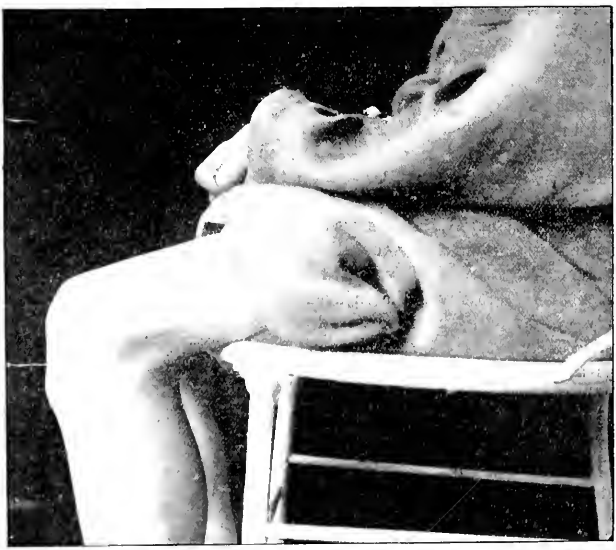
A few such experiences led me to consider more satisfactory methods of treatment. Having had gratifying results following bone pin graft methods which I had been using, I decided to attempt to stimulate early bony union between the tibial beak and the diaphysis by this means. The first case where I employed this technique was operated upon on October 3, 1915, at the New York Post-Graduate Hospital, T. G., a boy, aged 14 years, whose disability of left knee had extended over a year (see illustration attached). There was a decided local swelling, tenderness to pressure, and inability to fully extend the left leg. He could walk fairly well on the level, but with a limp, and in going up and down stairs he had to favor the injured leg, as he was unable to lift the body weight with the knee flexed and he kept the leg extended and pulled it up after him, so to speak. The technique of the operation was as follows:

Through an elliptical skin incision the area of the tubercle of the tibia was exposed. A longitudinal incision was then made directly over the tubercle, through the patellar ligament and underlying bursa. When the latter was opened it was shown to be distended with translucent gelatinous material which popped out when the knife passed through to its interior. There was marked thickening of the bursal wall and evident infiltration about this area in the tendon attachment The bursa was excised and the tubercle drilled, the drill passing into

the diaphysis of the tibia sufficiently to securely hold the bone pin, which was shaped from a segment of the antero-internal surface of the tibia to exactly fit the hole drilled. The pin was introduced and the excess trimmed off. The skin was closed by continuous catgut suture, dressing applied and a plaster of Paris cast fitted with leg in extension.

The patient was up in a wheel chair in a week, walking with crutches in two weeks, and in six weeks he was free from all discomfort, with free use of the knee-joint. I observed this case for about a year and there was no return of pain or disability.

The next two cases were both adults who were inducted into military service and sent to Camp Meade, Md. Both of these men had their injuries in adolescence and roentgenograms showed detached portions of the tubercles. I operated on both, hoping to produce more stability of the knee-joint. Before they were ready for discharge, I was ordered to Fox Hills General Hospital 41, so I am unable to report more than a few weeks' postoperative observation of these two cases. They were both up and walking when I left. In one I judged the knee-



THE ABOVE PHOTOGRAPH WAS TAKEN BEFORE OPERATION AND SHOWS CLEARLY THE ABNORMAL PROMINENCE OVER THE TIBIAL TUBERCLE WHICH SWELLING IS PARTLY ACCOUNTED FOR BY THE BURSAL ENLARGEMENT.

joint was improved in stability, but my opinion is that after such a lapse of time following the injury and with permanent changes in the functions of the knee-joint, it could hardly be expected to alter the condition very much.

The fourth case I operated on by the bone pin graft method was that of a girl—M. G., aged 13 years, who several months earlier, fell and struck her right knee against the curb. She was under conservative treatment by her local physician, who referred the case to me. Examination January 19, 1920, showed the local tenderness and swelling with limp and inability to fully extend the right leg or walk up and down stairs in a normal manner. The roentgenograms verified my findings and as ample time had elapsed under the usually prescribed method of treatment without relief, I advised this operation. I did not see the case again until March, 1920, when I was asked to operate. March 3, 1920, I operated by the pin graft method, following out the after-care as mentioned above, and to date she has been free from all symptoms and disability.

THE ABOVE PHOTOGRAPH WAS MADE FROM A LANTERN SLIDE OF X-RAY PLATES OF THE FOURTH CASE OPERATED BY THE AUTOGENOUS PIN GRAFT METHOD. (1) The tubercle before operation. (2) The tubercle after operation.

I do not offer this method as the method to be employed in all cases having this particular disability, but I do feel from the experience I have had in attempting to restore certain cases by the usual means that they do not always produce the desired result and that in the properly selected cases in adolescence the use of this method should produce the desired result, as it has for me in the two adolescent cases I have cited.

I have learned that fixation of the beak of the tibial epiphysis to the tibia has been done before by using a foreign material, but as introduction of foreign material has its objectionable features, I prefer, where possible, to use the autogenous graft.

The short period to a cure is an important factor to operator and patient, and this method would seem more definite and accurate when properly applied, though I realize that it should hardly be judged conclusively from the limited number of cases reported: still I offer it as an improvement on the inaccurate and uncertain methods heretofore employed.

AN ANALYSIS OF SEVENTEEN FRACTURES OF THE NECK OF THE FEMUR.

BY Z. B. ADAMS, M.D., BOSTON.

This is a fracture of old men and women. This list contains 17 women whose ages ranged from 48 to 84. The injury is usually caused by a fall on the floor.

There is no class of fractures which requires better judgment in the choice of treatment. What shall be done? How much with safety can be done? The fractures were described as mushroomed, 1; impacted, 5; intertrochanteric, 5; oblique, 1; transverse, 1; simple, 3; comminuted, 2; intra-capsular, 4; inter-capsular, 3.

Reduction was attempted in only 10 of the 17, spinal novocaine was used in five cases, ether in four. Brackett operation was done in one case. Whitman operation for reduction in eight. Held in plaster in seven cases: In Hodgen's splint suspension in one; Maxwell-Ruth in one. The Whitman plasters were suspended in Balkan frames. In no case was Campbell's very excellent method of getting the patient out of bed onto a high chair practised. This is difficult to accomplish in a large general hospital.

The two facts at times not recognized in these fractures are that (1) some of those at first firmly impacted become loose from an absorption of poorly nourished comminuted fragments; (2) the inter- and intra-capsular types unite slowly because the nutrition has been removed from the proximal fragment and this line of fracture is bathed in joint fluid.

The bed treatment was from seven to fourteen weeks with a few additional weeks in getting the patient out of bed and walking first with a walking chair, then with a Bradford abduction caliper splint and crutch, which treatment is continued for a year, gradually increasing this weight put on the line of fracture, which is always at a mechanical disadvantage even when abduction is maintained.

Results: Anatomical—Good, 7; fair, 5; bad, 4. Functional—Good, 8; fair, 5; bad, 4. Too early, 1; 2 paralyzed before fall. One case was three months old when admitted. One death from pneumonia. Shortening is from 1 cm. to 5 cm. The most frequent limitation to motion is loss of full flexion and much limitation of inward rotation.

DISCUSSION ON FRACTURE SYMPOSIUM

DR. JOEL E. GOLDTHWAIT, Boston: It is hard to know just how to approach the discussion of a series of papers like this, because it is probable that a group of men, trained as the members of this Association should be, can pass judgment upon the merits of these papers quite as well as I. It seems to me that perhaps my function, in a time like this, is to play the rôle of the old man—since I believe I am an Emeritus member of the Association—and suggest lines of caution.

The thing that we should keep constantly in mind, and that those who prepared the programme evidently had in mind, is that we are being judged by our results, and it does not matter how perfect the technique is, the results to the individual, (as Dr. Hawley says, the person who drives the machine) is the test. The papers represent admirable work. The paper, for instance, presented by Dr. Jones represents an attempt at team work which is in line with the idea given to us by Dr. Allison, in his paper last evening. It is a group of men, irrespective of what they call themselves, who, because of special fitness, are trying to accomplish certain end rseults. The thing that we must try to keep before us is sanity in the way we accept the work presented to us as a finished product by some experienced operator. For instance, I think the paper presented by Professor Putti yesterday was one of the most perfectly prepared and scientifical'y sound papers that I have ever heard; (applause) and yet I tremble to think of the harm that will probably follow the publication of that paper, as well as tragedies that will follow the publication of a paper like Dr. Hawley's, when it is read by a certain type of surgeon. I assume that Professor Putti thought the same thing; because three-fourths of his paper was devoted to the description of the selecting of the cases that were suitable for the operation. He then presented to you a most perfect technique, with results that were marvelously good. Dr. Hawley made a selection of cases also very carefully prepared and analyzed, and the results of ideal work; but it means that the selection of the cases was most carefully worked out. Otherwise, the results would not have been good.

We must look out lest we fail in this, and read only one part of the paper forgetting the three-fourths of the paper dealing with cautions. This is what we must do in our communications with the surgical groups, and make them read the three-fourths of Professor Putti's paper, as well as Dr. Hawley's article and the rest of the papers. Make them read the part that has to do with other things than the operation. Then, if they come to the operation, we shall have fewer tragedies than we will have otherwise. The very thing that Dr. Starr referred to in the part of the discussion that he closed last night, is the thing that we must not lose sight of. The best craftsmanship by the most carefully trained scientific mind, which thinks not only of the immediate operation—lots of people can do that,—but of the treatment in all of its details, with reference to the end-results.

That is what we must look out for. We have a marvelous lot of work, which should stimulate us to better work, but we must see that we thoroughly digest the work as it is presented, and do not see only some special phase of it.

DR. ORR, Lincoln, Neb.: Before discussing the papers that have just been read, I desire to pay my tribute of thanks to Sir Robert Jones for his many contributions to this meeting and particularly for his discussion of the subject, "Stiff Joints." I am sure we have all been greatly helped by what he has had to say on this subject.

In regard to the papers that have been read, one must, out of so much, select a few of the statements and discuss them only.

Dr. Goldthwait has dealt with some of the statements, it seems to me, quite too gently, and has even made the excuse that as he gets older he feels less strongly about some of these things. If, therefore, I treat some of the assertions that have been made somewhat more vigorously, I hope that you will not think that I am too young to have done so.

I desire to thank Dr. D. F. Jones for the presentation of his plans and work at the Massachusetts General Hospital. I feel that this is just the sort of thing that should be undertaken and developed, as one of the results of our war experiences. If better organization and more systematic methods can be evolved for the treatment of fractures, results are sure to be better also.

In Dr. Stone's paper, which Dr. Sever has kindly read for us, something is said about it having been found impossible in certain cases to obtain satisfactory position and firm union, so that operation was done and open treatment resorted to at the end of three weeks. In regard to such cases, I desire to make the suggestion that, if the securing of satisfactory position was impossible at the end of three weeks, it was probably also impossible at the end of three days. If open treatment is justifiable at all, it is usually justifiable and should be resorted to early. If, on the other band, a competent and experienced surgeon sees such a patient early, it will often be found that replacement and immobilization are not only possible but quite sufficient in most cases. In other words, operation should not be resorted to on the sayso of a surgeon who is not duly qualified and thoroughly experienced in splint methods.

In the same connection, I wish to emphasize the point brought out by Sir Robert Jones, with regard to the manipulation of old fractures when this is necessary to readjust old malpositions. It is of the greatest importance not to use pump handle methods; a single intelligent movement is usually the only manipulation that is required. And when correction has once been accomplished, perfect immobilization should obtain from that moment.

With regard to Dr. Peckham's paper, one feels that it is, of course, permissible, or necessary, or even wise to allow an individual surgeon, who becomes an expert with a method which he has developed, to go ahead and use it with the patients under his care. I certainly think it is a mistake, however, for a surgeon who employs methods in which one or a number of fundamental principles are disregarded, to undertake to teach that method to others. In a meeting like this where any one of the members is quite competent to work out his own methods such teaching probably does no harm. If methods for the treatment of fractures, however, in which such an important factor as immobilization is not given sufficient consideration are taught to students or others without much experience in treatment of fractures, much harm may be done.

Dr. Henderson makes one statement to which I wish to take exception and in which I am inclined to accuse him of having copied from the text books. He says that "prolonged fixation makes stiff joints." It is my idea that this should be "prolonged imperfect fixation makes stiff joints." My idea is that ankylosis as well as the adhesion of soft parts about a joint is due to damage to those parts by infection or traumatism, or both. If these fractures are guarded by suitable immobilization, ankylosis and stiffness are reduced just to that extent. If, on the other hand, infection or traumatism are aggravated by constant motion, in or out of a splint, ultimate stiffening is just so much greater.

Dr. Hawley's paper invites criticism. He made a great many dogmatic statements, some of which even seemed to contradict themselves. Dr. Hawley's ability and achievements are too well known for any one to think that I would undertake to differ with him very seriously, except on points of detail. However, when he says that loss of function and disability do not go together, he is apparently discussing the matter from a purely theoretical rather than from a practical standpoint. Preservation of function as a means of securing function for a patient is one of the most important things that an orthopaedic surgeon has to do, and as a rule, we find that impaired function and disability go hand in hand, and in almost exactly the same degree. He said also that there was no conflict between the mobilization of injured joints and the immobilization of fractures in the vicinity. Any one who has had experience in these, however, knows that the conflict between mobilization of joints and immobilization of fracture fragments nearby, real-

ly begins at the very moment of the beginning of treatment. And the difficulty of reconciling the mobilization of joints and the immobilization of fracture fragments really has been one of our most serious problems. When Dr. Hawley says later in his paper, that the more perfect immobilization is, the earlier is the return of function, he arrives at a conclusion with which I agree perfectly. I should feel very happy to have him adhere to the same principles in some of his statements regarding the splinting and other treatments of all other fractures and joint conditions.

Dr. Fred H. Albee, New York City: I certainly was much pleased with this symposium, which is a very timely subject for the Association at this time.

With reference to Dr. Hawley's paper, I should like to make a few remarks. If I understand him rightly, he lays down two fundamental principles, which are general and complete in their application, namely, traction and leverage. I certainly would like to add one more, namely, the position of neutral muscle pull, or a position that will relieve the displacement effect of certain muscles upon the fracture fragments by employing a posture which relaxes the offending muscles. The principle of the Balkan frame is largely based on this very principle, traction being applied in a direction which causes the displaced muscles to be relaxed until they are no longer able to contract, or in other words to exert a displacing influence. The most common example that we have illustrating the application of this principle is that of a fracture below the lesser trochanter, when the limb is put up in flexion and abduction.

I cannot agree that traction and leverage are the two sole fundamental principles in the treatment of fractures. Great emphasis was placed by Dr. Hawley on the fact that form had nothing to do with function. Form has a great deal to do with proper function; and when we defeat form, the form given by the Creator, there is likely to be interference with function; and when we restore form, we favor function.

Dr. Jefferson D. Griffith, Kansas City, Mo.: I want to thank the gentlemen for their symposium, and should like to speak on the subject of fractures of the femur. We who are beyond sixty years of age ought to remember that we get a fracture of the neck of the femur very easily, for in the last twelve months I have had to treat five fractures of the femur in persons beyond sixty, and in all of them, in getting down the history, I found that in every case the fracture had occurred first, and then the fall. One has a little trip, and in trying to catch oneself the fracture occurs, and then the fall comes as the result of the fracture and not the fall and then the fracture. In persons beyond sixty, I think that if you get the history clearly, you will find that this is the case.

I think that Dr. Peckham's paper is awfully good. I tried to treat two of these cases with the Whitman abduction, but I got a little too much abduction in one. Then I tried to treat by Dr. Peckham's method, and the patient is doing very nicely now. I have had a photograph taken. I think that we can carry this abduction business too far. I just want to show the President, here, a picture that he can look through easily. Here is a case of abduction. You can see right through it, and it gives a perfect picture of abduction carried too far, in the hip of a child four years old. That is absolutely solid. This did not break of itself. I broke it. I made a little bit of incision. I was afraid to chisel that from above downward, after Dr. Jones's method; but I chiseled it from below upward, and that is the result. In this case, I speak of the lordosis. I want to speak of that, because the lordosis of that back was reduced from a circle of six inches, and now it is straight. The expression that the boy made use of when he came out is very good. He looked up and down, and said to the nurse, "Sister, that is the only time that I have seen my feet together."

The other case is one of adduction. The leg was across there. This young girl had never walked on anything but crutches since the age of three, and she

is nineteen years old. That leg was clear across and I cut it in the intratrochanteric line, bringing it in line. Now she is well and doing her own work.

Now, gentlemen, I just want to say one word further about the Osgood-Schlatter disease. I have been unfortunate enough to have had three of these cases in their adolescence. I offered to operate, and they all turned me down, so I had to find some other way. In taking pictures, I found in the youngest one, eight years old, that there was secondary ossification there. I did not know what to do with it, so I made a basket strap, with complete relaxation of the quadriceps extensor muscle, put it up so that she could not use that muscle, and got a cure.

Dr. James Warren Sever, Boston: I should like to show some lantern slides of the Osgood-Schlatter method, if I can show these for a moment. This is the case of a well developed boy of sixteen, very muscular. He was preparing for a high jump. As he got ready to make a spring, he felt something give way. In the first lantern slide, you can see that he pulled the entire tibial tubercle off the crest of the tibia extending into the knee-joint. The knee was tremendously swollen and ecchymotic. He was kept in a splint for ten days. Then we cut down on it and put in a mattress suture. Two months later, he had a perfect knee with normal motion. I had never known of the possibility that the insertion of that bone could be pulled off to such an extent. It was easy and simple to put back, and both legs show the same end condition. The other is the same as that which was injured.

Dr. M. S. Henderson, Rochester, Minn.: I have nothing in particular to add. I agree with Doctor Orr in the main. However, I do not mean to imply that the stiffness which follows prolonged fixation is necessarily permanent nor is it an ankylosis. Nevertheless we do occasionally see cases where the limitation of the motion in the knee joint, for example, after a fracture of the femur is permanent, particularly in elderly people. What I have presented to you just now is really an abstract of the paper and in the full paper I tried to bring out the fact that this stiffness in the knee joint, which we only too frequently see in the prolonged fixation necessary in the Whitman method may be overcome by putting a joint in the cast at the knee. Every day the knee can be bent to a right angle, and fixation may be secured by putting a posterior splint along the cast.

Dr. Edwin W. Ryerson, Chicago: Dr. Orr's statement that the fracture is not immobilized, I wish to correct. It is immobilized while the mechanical treatment is being carried on.

Dr. Osgood: You have been kind enough, gentlemen, to suggest that I could give an account of the disease that, in spite of me, has received my name. It is a case of misnomer. Dr. Goldthwait told me, when I was a struggling young practitioner, that I might work up his cases. This I did I have never operated for this condition. The patients all get well with repeated adhesive plaster strapping. If they should prove resistent or if they were to be nuns or priests, I can conceive that it might be worth while to operate upon them so that they might not have an uncomfortable bunch to kneel upon, but our cases were relieved of stiffness by doing what Dr. Griffith says. I never thought of naming the disease after myself. It might be called sprain-fracture of the tubercle of the tibia. Some progressive Japanese, on looking up the literature of the condition, found that I had written first about it and named it after me. I want to protest against naming diseases after any man. It is a wrong method of naming diseases. A disease should be named for what it does on the basis of its pathology, or something of that kind.

News Notes

PROGRAMME FOR THE BRITISH ORTHOPÆDIC ASSOCIATION MEETING, Shropshire Orthopaedic Hospital, Oswestry, September twenty-fourth and twenty-fifth, 1921:

Saturday, Sept. 24th.

9.30 A.M. Executive proceedings of the Association.

10.30 A.M. Visitors to be shown around Hospital by the Staff.
Out-patient Clinic by Sir Robert Jones.
Demonstration of treatment of calcaneo cavus with cases, casts and x-rays, by Mr. Naughton Dunn.
Demonstration of plaster work by Mr. Aitken in the plaster room.
Talk on bone-grafting for tuberculosis of the spine in children, with cases, by Mr. Girdlestone.
Mr. Girdlestone.
Ward visit. Mr. Noble.
Demonstration of exercises in the gymnasium.

1.00 P.M. Lunch (at the hospital).

1.45 P.M. Visit to AFTER-CARE CENTRES.
Party No. 1 Shrewsbury
Party No. 2 Oswestry
Party No. 3 Wellington

7.30 P.M. Dinner at the Wynnstay Hotel, Oswestry.

Sunday, Sept. 25th.

10.30 A.M. Operations by the Hon. Staff:
(Operations as cases permit.)
1 Sir Robert Jones
2 Mr. Girdlestone
3 Mr. Aitken
4 Mr. Dunn

1.00 P.M. (onward). Lunch (at the Hospital).

THE EASTERN STATES ORTHOPAEDIC CLUB will meet in Baltimore November fourth and fifth.

Current Orthopaedic Literature

BILATERAL FORWARD DISLOCATION OF THE FIFTH CERVICAL VERTEBRA WITH REDUCTION BY MANIPULATION. Mitchell Langworthy. *Journal A. M. A.*, Feb. 12, 1921, p. 447.

Case of a man of 28 years in an automobile accident, head and neck being bent forward. X-ray showed, in lateral view only, a bilateral forward dislocation of the fifth cervical on the sixth, with slight impaction of the body of the fifth. Symptoms were priapism, numbness and tingling in the right hand and forearm and over the entire left lower limb. Frequent coughing with some fresh blood in the sputum. Knee jerks seemed normal. There was no motor paralysis and no gross eye findings. Respiration was difficult.

Reduction under an anesthetic by the method of Walton was accomplished. When the reduction was accomplished a dull bump was felt and no snap or click. Movements of the neck immediately became free in all directions.

The symptoms entirely disappeared so that on the fourth day the patient was allowed up in a plaster cast which supported the weight of the head on the shoulders.

Ten weeks after injury patient had no symptoms except some soreness and stiffness in the region of the ligamentum nuchae and trapezius muscle at the base of the neck.—*Lloyd T. Brown, Boston, Mass.*

LESIONS OF KNEE IN EX-SOLDIERS. F. J. Cotton, M.D., *Military Surgeon*, July, 1921.

Fifteen cases in all came to the operating room. These were in part cases of torn and displaced semilunar cartilages, but there were four cases of definite osteochondritis dessicans which proved to be of interest. Two cases had only adhesions following contracture, both from gunshot wounds, both stretched under ether, neither of particular interest save that intervention produced results according to a method perhaps not followed as consistently as it should be.

This method rests on the fact that, while "brisement forcé," the rough breaking up of adhesions, whether within or near a joint, fails of its object in the end, from the excessive reaction and the unavoidable aftertime of soreness that gives fresh stiffening, yet in the course of physiotherapy and gentle stretching under an anaesthetic, carry the range of motion just beyond this dead centre without entailing much soreness afterward, some adhesions may give

way but what we do in the main is to stretch taut tissues. A few days of soreness, mitigated by cautious massage, bring us back to the routine of limbering the joint gradually through a further arc.

"Brisement forcé" is out of date.

The author's way of handling loose, traumatic joints is to excise hypermobile semilunar cartilages, trim ruptured crucial ligaments, remove strip of fascia lata about three-fourths of an inch wide from the thigh. From the posterior lateral surface of the internal condyle, this fascia lata strip was inserted through drill holes and lashed, stitched, and fixed. This was stretched down anteriorly where it was attached in a similar manner to the anterior lateral surface of the tibial tuberosity, forming an artificial internal lateral ligament stretched over the healed but lax original ligament.

In the half dozen cases in which the author has done this operation results have been very satisfactory with no lax joints after operation, and he regards this as the operation of choice in the type called ruptured crucials, in which the joint has loose motion laterally as well as antero-posteriorly. The operative procedure does not repair the crucials, but it does stabilize the knee.

The series of cases of osteochondritis dessicans brings up two points: First, the nature of it; second, the frequency of secondary change from operation long delayed in cases of pure (or nearly pure) mechanical trouble in the knee. As to the author's four cases, one (Case 12) might be due to bodies grown from chipped off osteophytes, for there was an arthritis and there was no defect to account for the origin of the loose bodies.

Case 14 does for Ludloff's theory because the external condyle was affected.

Cases 12 and 15 both showed defects so far back and within the notch as to preclude any possibility even of direct trauma.

Cases 12, 13, 14 had definite bodies within the crucials, with untorn crucials, with bodies not in contact with bone (disposing of any theory of avulsion by ligament).

Cases 13 and 14 showed a distinct dissecting process, in one case leaving a vascular, in the other an avascular base and both showed excentric growth of the separated portion.

The second point in question is that of operative interference in general and of technique.

No one is likely to dispute the wisdom of taking out foreign bodies or torn, displaced semilunar cartilages, etc.

"The real point illustrated," the author thinks, "by this series is the frequency of secondary changes in lesions essentially mechanical of a variety of kinds." The author believes it fair to infer that "all kinds of mechanical defects in the knee-joint, neglected, may lead to secondary changes in the joint, changes that will not resolve themselves to normal, even with the irritant gone." —*J. M. Foley, Washington.*

MECHANICAL INFLUENCES IN SCIATICA. E. W. Fiske, *Pennsylvania Medical Journal*, June, 1921.

Inadequacy of its treatment. Undoubtedly the chief reason for the confusion lies in the usual methods of presenting the condition in medical teaching. It

is found in textbooks of general medicine and neurology as an entity, but little is made of it in works of surgery. As long as sciatic neuritis is considered a distinct disease and so treated, just so long will the underlying causes of this neuritis be neglected, with obvious failure of relief.

The secondary nature of sciatica is becoming more generally recognized. "Sciatica," as commonly used, does not differentiate between a neuritis and a neuralgia.

In twenty consecutive cases of sciatica which came under the author's observation in the past year, not one has failed to reveal an apparent primary cause in the low back. Three of these cases, representative of the group, are reported in detail.

The diagnosis made in twenty cases was sciatica secondary to sacroiliac strain in 55%, to lumbosacral lesion in 25%, to muscular back strain and myositis in 15%, and to possible bone infection in 10%.

Symptoms, according to percentages, in the twenty cases are reported in detail. Mention is made of possible bone anomaly as revealed by the x-ray in 15%.

The treatment was manipulation followed by fixation in 40%, fixation only in 60%. Of the cases manipulated, recovery occurred in 50%, of the fixation cases in 47% (17).

The author believes that in the majority of cases there is pressure by infiltration about the lumbosacral plexus as it crosses the sacroiliac joint. There may also be a reflex from an affected joint.

While we are still in the dark as to the effects and results of manipulation, the author advocates orthopædic examination in all cases of sciatica and orthopædic treatment where such mechanical causes are found.—*J. M. Foley, Washington.*

PAGET'S DISEASE OF THE BONES WITH POSITIVE WASSERMANN REACTION. Vallery-Radot, Stevenin and Fatou. *Bull. de la Soc. Méd. des Hôp. de Paris*, March 11, 1921.

Referring to the contention of Mentrier, Dufour and others that an argument in favor of the syphilitic origin of this condition is furnished by amelioration of pain following anti-syphilitic treatment, the authors present a case in point. All the characteristic features of an extensive and well-developed Paget's disease appear to have been present in this case. There was no history of syphilis, nor were any signs or stigmata found; but the blood Wassermann reaction was positive, and pupillary light-reflexes were lost. Mixed mercurial and arsenical treatment was followed by a decided relief from pain, which had previously been a marked and progressive feature. No claim is made by the authors that their case constitutes a confirmation of the theory that Paget's disease is of syphilitic origin. Reference is made to collective reports of 30 cases of Paget's disease in which the Wassermann test had been applied; seven were positive; twenty-three were negative.—*Rowdes Fayerweather*, Baltimore.

DIAGNOSIS OF POST-TYPHOID BONE AND JOINT DISEASE. P. Emile-Weil. *Bull. de la Soc. Méd. des Hôp. de Paris*, April 8, 1921.

Confirming the reports of Dufour and Sicard of the positive value of vaccine-therapy in these cases. Emile-Weil describes his own procedure, emphasizing the following points: (1) Of the various types of organisms, Eberth's bacillus is that chiefly capable of producing bone lesions; (2) before effective vaccine therapy can be instituted the type must be established; (3) especially must the lesion be distinguished from tuberculous disease; (4) both for establishing the type and for distinguishing typhoid from other chronic bone diseases the agglutination test is reliable, even after considerable lapse of time, or when anti-typhoid innoculation has been given. A portion of the article is taken up with statements in support of this last point. In discussing this communication, Dufour states that from a practical point a polyvalent vaccine from typhoid and paratyphoid organisms gives excellent results.—*Roades Fayerweather, Baltimore.*

CURE OF TYPHOID SPONDYLITIS BY VACCINE THERAPY. H. Dufour, Debray and Guyard. *Bull. de la. Soc. Méd. des Hôp. de Paris*, March 11, 1921.

A fourth case is added to three previously reported as successful. Symptoms appeared in region of second lumbar vertebra three months after onset of typhoid fever, and had resisted other methods of treatment. Serum agglutinated bacilli of Eberth's type 1/150. Vincent's vaccine of three types mixed was given: initial dose of 1/2 cc.; after four days, 1 cc.; nine days later, 1½ cc.; latter dose twice repeated at ten-day intervals. Pain and fever were controlled after the early treatments.—*Roades Fayerweather, Baltimore.*

HEMORRHAGIC OSTEOMYELITIS OF FEMUR. P. G. Lacroix. *New Orleans Med. and Surg. Journal*, April, 1921.

One case of hemorrhagic osteomyelitis of femur is reported of the lower part of left femur. Tumor removed and wound on each side of the knee closed by Willems method.

Immediate active mobilization gave good result and patient resumed his work four months after operation, using a caliper brace.—*Edward S. Hatch, New Orleans, Louisiana.*

RUPTURE OF TENDON OF INSERTION OF THE BICEPS FLEXOR CUBITI. John Joseph Nutt. *Journal A. M. A.*, June 25, 1921, p. 1825.

One case is reported in which the tendon was ruptured while patient was exercising on flying rings. Operation two days later, torn ends sutured with chromic catgut. Result excellent. Literature shows 65 cases.—*Edward S. Hatch, M.D., New Orleans, Louisiana.*

NONOPERATIVE TREATMENT OF FRACTURES OF CERVICAL VERTEBRAE WITH CORD INJURY. THE RESULT IN FOUR CASES. Michael Osnoto. *Journal A. M. A.*, June 18, 1921, p. 1737.

The problem as to whether a case of cervical cord injury should be operated on or not is a delicate one. Elsberg says that operative interference in a complete transverse crushing of the cord is useless, but an operation may be necessary if there is no complete transverse lesion. The dangers of operating on the cervical cord are œdema and consequent interference with the functions of the vagus and phrenic nerves.

Four cases are reported. The first one was probably a complete crush of the cervical cord and the patient died. The other three recovered. It is probable that a greater mortality would have resulted with operation.—*Edward S. Hatch, M.D., New Orleans, Louisiana.*

THE SURGICAL ASPECTS OF INJURIES OF THE BRACHIAL PLEXUS. Alfred W. Adson. *N. Y. State Journal of Med.*, Sept., 1921, p. 331.

This article is based on a study of 101 cases of brachial plexus injury recorded in the Mayo Clinic since 1910.

Of these 45 were birth palsies, and in all but five there was a history of difficult or operative delivery. Shoulder dislocation was found present in 13 cases. The incidence of this condition was much greater in the age group above two years than in that below, from which he argues that Thomas' theory of shoulder dislocation with laceration of the capsule and resultant axillary inflammation as the etiology of the lesion is not borne out. He concludes that it occurs as a consequence of paralysis. Treatment of the condition was attended by great improvement in function, the greatest improvement occurring in those below the age of two. He does not describe the treatment used.

Fifty-six cases of traumatic brachial paralysis were studied. These were produced by trauma to the shoulder and neck without fracture, 23; by trauma associated with fracture or dislocation of the clavicle or humerus, 12; by belt injuries, 13; by gunshot or stab wounds, 8. Twenty-five were operated and in those where the brachial plexus was explored the findings were usually laceration of the nerve roots close to the intervertebral canal with such wide involvement in scar tissue that it was only rarely possible to resect and anastomose. Fourteen of the 25 operations were failures, 11 were improved to approximately 40% function; 32 patients were not operated upon but treated medically; four were failures, 26 had 45% return of function. Failure resulted in 58% of the operated cases, and in 15% of the unoperated cases.

Adson presents a preliminary report on experimental tears of the brachial plexus produced on the cadaver. He concludes that while production of complete laceration or avulsion is difficult, it is possible, and depending on how the force is applied may affect either the upper or lower part of the plexus with avulsion of the sympathetic ganglion. Owing to the proximity of such injuries to the intervertebral canal, repair is difficult. Many of the brachial plexus palsies are the result of lacerations of the cervical fascia, epineurium,

perineurium, fasciculi and blood vessels rather than of complete laceration or avulsion.—*P. D. Wilson, Boston, Mass.*

IS SCIATICA A SYMPTOM OR A CLINICAL ENTITY? William J. Leszynsky. *N. Y. State Jour. of Med.*, Sept., 1921, p. 337.

The author argues from his own experience with a large number of patients that sciatica is a clinical entity in about 75% of all cases and that only in the remaining 25% it is secondary to affections of the lumbosacral, sacroiliac and hip articulations or intrapelvic troubles.

For treatment of the condition he advocates rest in bed, with thorough emptying of the lower bowel and application of heat and sedatives. In severe cases hot saline rectal irrigations, followed by suppositories of opium and belladonna.

He has used with success perineural injections of salt solution, but finds that the injection must often be repeated several times before relief is obtained. He has used injection of saline solution, with or without novocaine, into the sacral canal in about 50 cases and finds it invaluable for the treatment of subacute or chronic cases. It is the most effective agent he knows.—*P. D. Wilson, Boston, Mass.*

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The Journal *of*
Orthopædic Surgery

THE PRINCIPLES OF THE SURGERY OF THE PERIPHERAL NERVE INJURIES OF WARFARE.*

BY HARRY PLATT, M.D., M.S., F.R.C.S., MANCHESTER, ENGLAND.

From the experience derived from a personal study of more than 1500 patients suffering from gunshot injuries of peripheral nerves, and particularly of a series of over 500 operations, it is proposed to bring forward in brief form some of the considerations which have appeared to the writer as of outstanding importance in connection with this field of surgery. It must be admitted that in one's own work as in that of many other surgeons, postoperative end-results are not forthcoming except possibly in a very limited number of cases. But although such definite knowledge is lacking, much valuable information has been acquired. In a large series of operations one has had many opportunities of investigating the living pathology of injured nerve trunks. Further, the mechanical problem encountered in connection with the actual surgical repair of nerve lesions has caused us to resurvey the physiological and anatomical foundations of peripheral nerve surgery, and to realize the influence of certain factors in determining our surgical attitude towards any given type of lesion. Then again, a study of interim results, and in general a consideration of the regenerating nerve under many widely varying abnormal conditions, has contributed also to the formation of a reasonable surgical attitude.

* Paper read before the American Orthopedic Association at the annual meeting in Boston on June 4, 1921.

FACTORS INFLUENCING THE SURGICAL ATTITUDE.

Physiological Considerations.

Although the bulk of the evidence from all methods of observation may be said to be in favor of the adoption of the central theory of regeneration, it is unnecessary to be unduly dogmatic on this point. Whatever may be the exact limitations of the capacity of the peripheral part of the nerve trunk to share in the regenerative process as a whole, it is to be recognized as essential in surgical repair that there should be no obstacle to the access of the axis cylinders of the proximal trunk to the neurilemmal sheaths in the distal trunk. But the importance of the controlling influence of the spinal cells in the phases of regeneration must not be overlooked. The prolonged existence of a block in the peripheral nerve is always associated with marked retrogressive changes in these cells. In time, the cells lose their full capacity for the exhibition of a perfect control of the regeneration. It is not certain also that having once initiated the regenerative process, after the production of a second new lesion, these cells can repeat with success their regenerative domination. Thus, we see the importance of the early repair of a nerve lesion—early suture—and also the risk involved under certain circumstances, in the deliberate production of a second complete lesion at operation after regeneration has been established.

Anatomical Considerations.

Apart from the obvious essential general anatomical knowledge connected with the surgical exploration of nerve trunks, three considerations are deserving of special mention.

1. *Nerve Topography.* A crude but inconstant internal anatomy may be assumed to exist in the case of most of the larger nerve trunks, and particularly in the sciatic nerve, and in the median and ulnar nerves in the upper arm. In its surgical application, topography is of importance in relation to (a) the mechanics of end to end suture, where the avoidance of longitudinal rotation of the proximal and distal stumps is to be considered fundamental; (b) the feasibility of the recognition of partial lesions and their conservative resection. This it must be confessed is a theoretical rather than practical application, and (c) the condemnation of the operations of nerve anastomosis which

are either topographically inexact and useless, or if by any chance accurate, involve an unjustifiable degree of destruction of the recipient health nerve.

2. *The Muscular Branches of the Peripheral Nerves.* An exact knowledge of the position, distribution, and number of the muscular branches of the nerves commonly exposed at operation is essential to the surgeon. Confusion may arise in the investigation of the neurological syndrome if it be not remembered that direct lesions of muscular branches often coexist with lesions of the nerve trunk proper The procedure of stripping such branches from within the sheath of the parent-trunk, or conversely of freeing them in their extramuscular course, is one of the most important manœuvres in facilitating end-to-end suture in the case of extensive gaps. Occasionally the sacrifice of one or more branches may be required to attain this end, and where a double supply exists to any particular muscle, such a sacrifice will happily produce no added disablement to the patient.

3. *The Blood Supply of the Peripheral Nerve Trunks.* The wide freeing of nerve trunks, which is a commonplace in the repair of many of the warfare lesions, involves of necessity the obliteration of a considerable part of the vascular supply derived from extraneural sources, and this especially in the distal part of the limb. Such extensive dissections have been shown to produce no ill results as regards the occurrence of gross changes in the component tissues of the nerve trunks so dealt with nor any inhibitory effect on regeneration. These conclusions have been confirmed by the experimental work of Torraca.

Pathological Considerations.

There has been a tendency to apply many of the established principles of civil nerve surgery en bloc to the treatment of the warfare lesions. In the nerve lesions of civil life, "secondary" injuries—compression lesions—constitute a large and important class. But the warfare injury is notably primary in its inception, the actual nerve block is intraneural in position, and the conduction of the trunk is little influenced by extraneural conditions. For this reason the operation of simple neurolysis is here likely to play a subordinate part.

The dominant rôle of wound infection, whether attenuated or moderately severe in type, which is characteristic of the injuries of modern warfare, provides in addition to the gross primary lesion of the nerve, the insidious extension of interstitial neuritis for considerable distances proximal to the limit of the initial lesion.

THE OPERATIVE EXPLORATION OF NERVE INJURIES.

General Considerations.

Of the many important points which cannot be dealt with fully in a short paper one would lay emphasis on the following: (a) the routine use from the commencement of the operation of the widest anatomical exposure; (b) the constant employment of direct electrical stimulation by means of the bipolar electrode; (c) the standardization of such positions of the patient and limb on the operating table in which the difficulties of obtaining end-to-end suture are minimized.

Result of a Series of Operations.

In my own series of 510 operations performed up to December, 1920, information concerning the late results has been accumulated in 248 patients. These operations include, end-to-end sutures, 150; neurolysis, 80; bridging operations (grafts and tubulizations) 18. In connection with the latter group of operations the complete failure of all my personal operations of this type was reported a year ago, so that no further reference will be made to them here.

A. Suture Results. Of the 150 operations, recoveries of varying types and degree were seen in 79% and complete failures in 21% of the cases. Amongst the factors which have determined or inhibited recovery and which are worthy of discussion are the following:

1. *The Period Since the Injury.* With increasing periods of delay are seen progressively inferior results. This is due, in my own view, not necessarily to the development of degenerative changes in the muscles, but to the retrogressive changes in the spinal cells already referred to.

2. *Infection.* Immediate postoperative recrudescence of infection occurred in one operation only in my series of 510, so that one has had no personal opportunity of confirming the generally assumed disastrous effect of such a mishap on the process of regeneration. Infection has been seen, however, at a period remote from the time of the operation, manifested as a spontaneous recrudescence in some previously encysted focus, particularly in connection with a coexistent bony injury. Further, in a number of sciatic nerve injuries, the development of bone necrosis in the head of the fifth metatarsal or distal

phalanx of the great toe, occasionally associated with trophic lesions in these regions, provides a distal source of sepsis which I believe is absorbed by the regenerating nerve. Its effects are shown in the delay in regeneration in such cases and also in the production of symptoms of irritation in the internal popliteal distribution during the recovery stage. This sequence of events has occurred in a number of sciatic injuries in my own experience.

3. *The Nerve Bed.* From my observations the effect of the surroundings of the sutured nerve has been almost negligible as regards the regenerative process, except where the nerve trunk has been subjected to the friction of bony surfaces, or left in direct contact with injured tendons.

4. *Topography.* Topographical errors inevitably account for many of the total failures or imperfect recoveries, and may be taken as explaining in part the superiority of the recoveries seen in an almost purely motor nerve, such as the musculo-spiral. Again, the failure of suture of a small nerve to a larger trunk, or of two small nerves to a common large trunk, which is a conspicuous feature in a number of my operations, is to be explained by an inexact topographical apposition.

5. *The Level of the Suture.* Our observations go to show that regeneration in the distal part of the limb is apt to be fickle, irrespective of the level of the lesion or suture. This has been pointed out some little time ago by my colleague, Stopford, and has also been emphasized by Stracker of Vienna.

B. Neurolysis Results. In 75% of the cases followed up, improvement and recoveries were seen, but it has been difficult to prove the exact influence of this operative procedure *per se* on the restoration of conductivity.

THE QUESTION OF LATE EXPLORATION AND REËXPLORATION AFTER FAILURE OF PREVIOUS SUTURE.

At the present time the optimum period for exploration of the nerve injuries sustained in 1918 is past. For the few unexplored lesions of a date previous to this, an even worse prognosis is to be given. The same criticism applies to the reëxploration of failures, so that the alternative operations for the restoration of function now loom large in our repertoire of reconstructive procedures. These latter are now practically standardized and their consideration does not enter into the scope of this paper.

	Total	Proximal Muscles only	Proximal and Distal (incomplete)	Proximal and Distal (total)	Distal Alone	Associated Sensory Recovery	Sensory Recovery Alone	Number of Recoveries	Failures
Musculo-spiral	35	10	11	5	—	all	—	26	9
Median-upper arm	10	7	3	—	—	in 5	—	10	nil
forearm	20	3	—	—	6	in 6	8	17	3
Ulnar-upper arm	27	19	3	—	1	in 14	1	24	3
forearm	20	—	—	—	10	in 11	7	17	3
Sciatic-trunk	21	16	nil	nil	—	in all	—	16	5
segmental	4	2	nil	nil	—	in all	—	2	2
External poplital	9	4	nil	—	—	in all	—	4	5
Posterior interosseus	1	—	—	—	—	—	—	nil	1
Plexus	3	2	—	—	—	2	—	2	1

Recoveries 118=79%
Failures 32=21.3%

	Suture	Neurolysis	Bridge	Repair Abandoned	Partial Suture	Exploration No Lesion	Exploration Nerve Left in Situ	Injection	Exploration First Stage	Total
Brachial plexus	5	4	—	—	—	2	—	—	—	11
Musculo spiral	51	15	5	11	—	1	—	—	—	87
Median	70	45	6	—	5	2	3	1	—	132
Ulnar	115	49	12	-	—	1	5	—	—	182
Posterior interossens ...	1	—	1	—	—	-	-	—	—	2
Sciatic	51	9	3	—	2	1	—	—	4	70
External popliteal	11	2	—	6	—		—	—	—	22
Internal popliteal		2	—	—	—	—	—	—	—	2
Posterior tibial	—	1	1	—	—	—	—	—	—	2
	307	127	28	20	7	7	8	1	5	510

Operations for severe causalgia: Median, 14; sciatic, 10; internal popliteal, 1=25
Operations in which end-to-end suture failed. 53
Successful suture at second attempt 1
Failure of suture at second attempt 3

DISCUSSION OF MR. PLATT'S PAPER.

Dr. Edward Gallie, Toronto, Canada: *Mr. President and Gentlemen:*—It is impossible for me to assist Mr. Platt very much in discussing this paper, as our experience in the Canadian Army has been so similar to his that a detailed discussion would simply be a repetition. I might draw your attention to several points in the paper which it would be well to remember.

In the first place, the experience of the war has shown that the suture of injured nerves is an operation from which very satisfactory results may be anticipated. Despite the serious nature of the original injuries and of the subsequent infections, an extraordinarily high percentage of good results has been recorded. In civilian practice, therefore, we should profit from our war experience and give every patient suffering from such injuries the opportunity of obtaining restoration of lost function by suture of the nerves.

In the second place, the old dispute as to how regeneration of the nerves takes place appears to have been definitely settled. The investigations of the Medical Research Committee have shown that recovery takes place as the result of the slow downward growth of the axis cylinders from the point of the lesion. No authentic cases have been observed in which recovery took place more rapidly than could be accounted for by this downward growth of the axone.

With these preliminaries definitely decided, the most important question to the student is how to account for the variation in results obtained from operation. It has been generally accepted that in order to establish any certainty whatever of a successful result, actual end-to-end suture of the nerve must be obtained. While partial recoveries occasionally occur after nerve grafts, fascial tubulization, etc., these are so rare and the functional improvement so slight that such operations are really not worth while. Every effort should therefore be made, by dissection, mobilization of the segments of the nerves or by flexion of the joints in the region of the injury, to bring the ends of the nerve together. If this is finally shown to be impossible, the suggestion of drawing the bulbs as closely together as they will come, with silk, and leaving them so for a couple of weeks will often make end-to-end suture still feasible. I have seen a gap of two inches ultimately closed by this method.

My experience has led me to believe that the character of the results depends very much upon the way in which the suture is performed. I feel sure that the rather high percentage of failures which followed my earlier operations was due to unskillful technique. This percentage of failures steadily diminished as we improved our technique, particularly in the matter of the gentle handling of the nerve, the accurate approximation of the cut ends, the taking of care that one segment was not rotated on the other, and the use of fine needles and delicate sutures which entered only the sheath of the nerve. Many operators have found that after long and difficult dissection necessary to get the nerve ready for suture they are too exhausted to do the delicate work necessary to obtain an accurate closure of the wound. In such cases it will be found useful to have another operator take charge of the final stage of the operation.

We have been so impressed with the importance of accuracy in suturing the nerve that recently we have used a large magnifying glass placed between the operator and field of operation. This so enlarges the structure that accurate suture is easily obtained.

Mr. Platt has drawn attention to the importance of carefully splinting the limb in such a position that dangerous tension on the nerve will be avoided. This is comparatively easily secured in the case of the arm and leg but is more difficult in wounds of the sciatic nerve. A plaster spica applied with the hip extended and the knee flexed makes it difficult for the patient to lie comfortably in bed. To get over this difficulty we adopted the plan of placing these patients in beds which were so constructed that a space could be made between the sections of the mattress and part of the springs removed, so that with the patient lying on his back his leg passed through the bed and his foot rested on the floor. He could thus wear a plaster spica in comfort.

Dr. Murray S. Danforth, Providence, R. I.: I feel that we are to be congratulated on the fact that Mr. Platt has been able to follow so many of the cases that he had previously done. I recently attended a meeting of the United States Army Peripheral Nerve Commission in which the various men told their experiences in trying to follow up their cases, and of the difficulty of getting accurate reports, with the patients scattered in various parts of the country.

It was very discouraging, although in some instances the men had been able to correlate their previous examination and operation with the present condition of the patient. It is only by getting the carefully prepared reports of Mr. Platt, the reports of the work at Edinburgh recently presented by Dr. Forrester-Brown, and the work of the men in Canada, together with the reports of the comparatively few cases done in the United States that the hoped for contribution to neural surgery could be made.

I feel that I can add very little to what Mr. Platt and Dr. Gallie have said, but there are one or two questions that I hope Mr. Platt will answer. One of them is the question of the relief of pain in some of the cases of nerve injury where suture has been done, and where exploration has been done and some change in the nerve found, but not a change in the nerve that required resection. What can be done in these cases to relieve the pain? This is of importance to the surgeons in charge of soldiers still under treatment in the United States.

There is one other question to which possibly the answer was suggested in a paper given by Dr. Harris before the Orthopaedic Club. In a case of loss of sensation in the median area, where it had been impossible to suture the nerve, Dr. Harris took the ends of the radial and anastomosed them with the peripheral part of the median nerve. He reported one case in which this procedure was followed by considerable restoration of sensation in the median area. I should like to ask whether Mr. Platt has had any experience in this.

The point brought out by Mr. Platt of the possible lack of value in electrical stimulation at a secondary operation, where suture had been made without restoration of power, is of interest. I understood him to say that electrical stimulation might produce contraction of the muscles, but that it was produced through the sensory fibers. It is a point of very great value to know; otherwise, we shall be deceived.

The point brought out by Dr. Gallie that in cases where it has been impossible to bring the nerve stumps end-to-end, one can anchor the stumps in as close approximation as possible and at a second operation, do an end-to-end suture—is of value, as end-to-end suture only is of value in restoring function.

Mr. Harry Platt, Manchester: Dr. Gallie has had a wide experience in operating on these cases and I do not think my views differ very much from his. The arrangement whereby two surgeons are employed, working in shifts in a long and tedious operation of nerve suture, is an admirable one.

The operation of Harris of Toronto I have not done yet but I am expecting to try it on a patient in a very short time.

With regard to the question raised by Dr. Danforth on methods of relieving pain, I must say that in a number of my sciatic nerve sutures in which severe pain has followed during the time of regeneration nothing has been found to give relief, and I am afraid that I know of no form of treatment which can effect this with certainty.

PREVENTIVE AND PROPHYLACTIC ORTHOPÆDIC PRACTICE.

BY C. L. LOWMAN, M.D., LOS ANGELES, CALIF.

As orthopaedic surgeons we are, and have been, actively engaged since 1914 very largely with operative and reconstruction work. Many hundreds of the younger men of the profession have taken in-

tensive orthopædic training and have been dealing almost entirely with the results of war injuries and their sequelae, as well as those questions of faulty statics which are evidenced in soldiers.

The surgery of war injuries has emphasized the necessity for prophylaxis in regard to future function of parts, and the positions for usefulness of various members have been pointed out over and over again.

The orthopædic clinics in our army hospitals have large numbers of cases in which faulty statics played the greatest rôle in the causation of disability.

I have been interestedly noting the fact that probably 80 per cent. of the soldiers who present themselves complaining of back symptoms, especially referred to the low back, are of the long backed type with varying degrees of malalignment, and in more than half of them various anatomical deviations in the sacro-lumbar region are seen in the x-rays. We do not yet know the exact relation of these deviations to the symptom complex, but the frequency with which we get these findings seems to me to be more than a mere coincidence.

The enormous number of postural cases, both rejected from the service and still in the service has been pointed out and talked of until it is common knowledge, and the rejected and discharged for foot defects alone, when the final figures are compiled, will certainly be great. When we stop to think what the causes of these disabilities are, and remember that findings of many investigators show that 70 to 85 per cent. of all our school children have postural defects, the relation seems perfectly obvious.

Under the strain of military life, the potentially weak break down, and the same holds true in civil life, except that the stress and strain is applied more gradually and the disabilities are not apparent at so early an age.

Although orthopædic surgery is a specialized branch of surgery, it has a very broad outlook and many angles of activity.

The surgical corrective aspect deals with pathological and reconstructive problems. Preventive surgery deals not so much with the operative as with the nonoperative type.

Perhaps the more spectacular surgical side is alluring to some, but certainly the influence of preventive surgery on the health and efficiency of the coming generation will give as great returns in helping to increase human happiness and usefulness.

The field for preventive effort is large and many angles might be

discussed, but I desire to bring to your attention only one phase, namely, physical supervision in childhood.

As I have just stated, it has been shown many times by examiners of groups of unselected school children that from 70 per cent. to 80 per cent. are physically defective from a postural standpoint.

If this is so, and the need for corrective procedures is so self-evident, the question arises—who is to be responsible for the institution and carrying out of these corrective procedures?

It is safe to say that in general, at least about 50 per cent. of the orthopædic surgeon's office practice consists of adults, and in varying degrees, according to the interest and importance attached to faulty statics, the conditions for which these adults are treated are functional faults.

Joint conditions, due to improper weight-bearing, with or without other definite pathology, arthritis, periarthritis, periostitis, neuritis from such conditions as flat feet, pronated ankles, knock-knee, torsion deformities, short leg, faulty spinal alignment, in one or both planes, disturbances of alignment and weight-bearing in the pelvic and shoulder girdles make up a large part of our daily work.

How many cases of subscapular bursitis and other shoulder girdle neurites, from use in malposition, must we see in the adult before we realize that had proper attention been given in the growing years, this end-result would have been avoided?

How long are we going to teach that moderate degrees of bowlegs in children will be outgrown, when our offices and clinics are full of adults with valgus ankles and flattened feet because of moderate, uncorrected bowleg?

The apparent correction of the deformity by close apposition of the legs is simply due to the fact that a compensatory angle has occurred below the ankle, caused by the weight being thrust inward by the curved tibial lever.

In latter years the result of flat feet and other disturbances of leg alignment ensues. No amount of ordinary treatment can give these adults anything but symptomatic relief.

The same is true to a lesser extent of knock-knees, but more attention is directed to this in childhood and more corrections obtained.

Torsion deviations: Rarely have we seen much attention given to this condition, which is quite common and causes ultimately nearly as much joint and muscle strain and tissue changes as deviations in other planes.

How long are we to treat scoliosis caused by short legs before we

attempt to institute some general action looking to the discovery early in life of the factors which underly the curvature?

We certainly have all seen and appreciated the wonderful improvement in health which is manifested in a body of soldiers after the routine drill and setting up work has straightened their spines and corrected to a large extent the general tendency to visceroptosis.

We know their physical efficiency as well as their health is improved. Why should we not give to all the coming generation the value of the lessons in physical efficiency which our experience in the army has given us?

Reconstruction work is a very necessary thing in war and the industries, but there should not be much need for it during childhood.

Constructive work is wanted here, the prevention of those conditions which most certainly are important factors in lowering the health and efficiency standard in the adult. Our own children probably fall in this class, which is 80 per cent. of the total number of school children.

How is a program of constructive physical supervision and education to be brought about, and who is going to do it? We have a growing group of men and women engaged in physical educational work, only a small percentage of whom know much of corrective methods. As a class they are enthusiastic, willing, and interested in this problem, but they lack guidance.

Only in our large centers do they come in contact with orthopædic procedures, and even there only the high schools and colleges have gymnasia, so that there is practically very little attention given to the postural defects in the grammar grades.

This is expressly the age when the most careful work should be done. Shall we continue to leave the responsibility of training physical directors entirely in the hands of *educators?*

If the methods in use do not meet the needs in this matter of corrections, changes must be made. Should we not be the ones to suggest the changes?

We should be the ones to outline for the physical directors the necessary procedures, looking to the correction and prevention of postural defects. More of us should have a hand in the training of those entrusted with so important a branch of our work. Most of us are training directors for our office and clinical work, but very few have in any way modified practically the methods in vogue in the physical supervision and training of those handling the mass of our school children.

The most effective and far-reaching work must be done during the grammar school age. As gymnasia in grammar schools are seldom seen, all the exercise the children have, which could have any corrective value whatever, is given by the grade teachers under a general supervisor who is responsible for all the grammar school work in the city.

It is not too much to demand that a trained physical director, schooled in preventive methods, and competent to recognize potential defects and deviations, should be assigned to each school. It should be her duty to act in an advisory capacity to both teachers and parents, to look over and observe all children who need special attention to their physical needs. She could refer these cases to the proper examiners and carry out their recommendations as to any general procedures decided upon.

Supervision of games is a particularly important phase of this work, and it is possible by intelligent choice to arrange certain activities to meet certain needs and to check vicious activities, such as some form of folk dancing, jumping rope, skating, etc., in children with flexible flat feet.

All physical activities can be altered to meet the gross needs of the group and will thus result in greater value to the individual.

We have found that a rough classification can be made by an examiner properly trained, sufficiently accurate to divide most of those with obvious defects like pronated ankles, flat feet, knock-knees, round shoulders, round or hollow backs, unlevel hips and shoulders, from those more nearly normal.

Briefly, the method we have employed is this: At the beginning of the quarter or semester, the new pupils are lined up and the examiner, accompanied by a secretary, passes down the line and notes, first, all cases of unlevel shoulders,—again, passing a hand down the curve of the waist and hips and then placing the thumbs on the anterior superior spine of the ilia, unlevel hips or tilted pelvis are noted.

The secretary notes the pupil's name, each time under each defect. Lining them up again, the examiner approaches from the end of the line, passing the hand over the back, notes prominence of scapulae, round, flat or hollow back, and head position.

Position of the squad is again assumed and by slight pressure backward on the knee as well as by direct inspection, back knees are detected. Next, have the pupils stand with feet parallel, knees touching. Those whose malleoli touch and condyles do not, obviously have varying degrees of bowlegs and the converse detects knock-knees.

In the feet parallel position, if the patella points toward the median line of the body and not forward in the median line of the leg, there exists inward rotation of the leg and compensatorily pronated ankles or relaxed arches.

Bring the class to attention again without calling attention to their feet and note foot positions. In gymnasium slippers it is easy to observe faults in foot alignment and notation is made as to pronation and relaxed feet.

When this data is assembled it will be found that certain ones will be registered for two or three defects, or, in a word, are generally relaxed. This worst group should have immediate attention. Word should be sent to the parents for permission to make a detailed examination with clothing removed, and in cases that need expert attention they can be referred to the proper clinics or orthopædic surgeon for necessary care.

In this way there will not be a loss of a month or more before the examiners are aware of some of the worst cases, and, furthermore, they would not be able otherwise to estimate the size of the groups needing special attention to certain things.

On this basis they can adjust their corrective and general gymnastic procedures.

Fifty or sixty pupils can be thus roughly gone over in an hour and with a little experience and knowledge of types the gross errors can be detected.

In any group of school children fully 65 per cent. will have two or more of the above mentioned deviations; consequently, the earlier they can be recognized, and the earlier any or all of the proper prophylactic procedures can be instituted, the better for the children thus afflicted.

The worst cases could be taken out in squads and have special exercises given, but as it will take some time to get to this stage, a good start can be made by modifying as much as consistently possible all the games and activities which will influence these conditions.

Supervision should also be extended to physical surroundings, seats, desks, chairs, etc., and their adjustments examined to see that they are correct for the various children under consideration.

In acting in an advisory capacity to the parents, much good would ensue. Inquiry should be made in regard to the child's habits and activities while out of school, home surroundings, bed postures, feeding, hours of play and sleep.

Clothing and its effect on posture should receive its share of con-

sideration, and most mothers are very glad to be informed as to correct corsets and corset waists, brassières, etc.

Whenever it is possible to have gymnasium facilities, the supervisor of corrective activities should change type, order, and progression of exercises to obtain the greatest individual benefits to the whole group taking work under her.

One example of this would be shown, for instance, by a method which we had used in our gymnasium for years and which has been subsequently used in several schools in our vicinity, namely to plan out a whole progression of exercises given in recumbent, procumbent or sitting positions. We have long advocated that enough stools and mats be included in the gymnasium equipment to make this possible.

You probably know the value of toning up exercises in these positions and use them in your own practice as I do, but they can be used as well in group work as with individual cases.

Some of the advantages of the method are, briefly: The lying position rules out the effect of lateral asymmetries, such as short leg, unilateral flat-foot, or knock-knee with its pelvic tilt, and scoliosis.

The straightening out of all spinal curves in the early stages.

The fixation of the scapulae and corrective effect on antero-posterior curves.

The margin of safety allowed in reference to heart and respiratory strain.

The improved position of the viscera.

The sitting posture is an especially good one in flattening the lumbar curve while the shoulder, scapular, and chest exercises are given.

Fatigue is not developed so rapidly because of the lessened balance strain.

In short, it allows corrective work to be given in corrective positions, a statement which should be axiomatic.

Instead of having the high majority with postural defects stand and exercise in positions of faulty alignment, is it not better to have the small majority who are normal assume the positions and do the work which will gain the maximum good results for the needy majority?

I recognize the fact that in two or three of the larger centers where there are many orthopaedic surgeons, some of them have long been giving time and thought to the development of physical trainers and gymnasts, but through the country at large how many state normal schools, colleges, and universities giving major courses in physical

training, have orthopædic surgeons on their faculties or even remotely connected with them?

It is perfectly obvious that there are not enough men interested in orthopædic work to see even a fraction of this 80 per cent. of children who need the attention of trained individuals. Consequently, if this field is to be cultivated and a harvest gained, it will have to be done largely by men and women trained to do it.

All of us who are or have been connected with the reconstruction work appreciate that a great part of the credit for the results obtained belongs to our Reconstruction Aides, the greater number of whom are physical directors.

We are keenly conscious of the difference in value to this work of those who are experienced directors and those who had simply some special and intensive training.

This fact alone should make us realize that the well trained physical directors, who are graduated from schools giving courses in corrective orthopædic therapy, are to be the ones to transform our desires into facts, in dealing with this phase of the preventive and prophylactic problems of childhood.

The founder of orthopædic surgery included the postural and potential deviations in childhood within the purview of this branch, and it seems as though the responsibility for training these persons rests with us.

If, then, we will assume our share in the education and training of physical directors, we should use our influence to broaden the scope and raise the dignity of physical training as a scientific branch of education.

PRIMARY OSTEOMYELITIS OF THE PATELLA. CASE REPORT.

BY E. B. MUMFORD, M.D., INDIANAPOLIS, IND.

Assistant in Surgery, Indiana University School of Medicine. Visiting Orthopædic Surgeon and Chief of Fracture Service, City Hospital, Indianapolis, Ind.

R. B., white, aged 13, living on a farm, fell September 6, 1919, while playing ball and injured his right knee. There was not much pain at

FIG. 1.—Osteomyelitis of Patella.

FIG. 3.—Osteomyelitis of Patella.

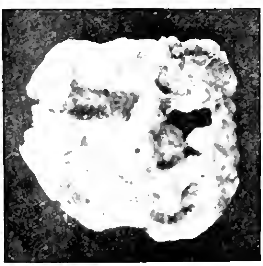

FIG. 2.—Osteomyelitis of Patella. Sequestrum.

that time and he continued with his play. The second day following the accident he began to have pain in his knee and at the end of two hours had to be taken home as he could not walk. At this time the attending physician noted that the knee was swollen and there was some redness over the anterior aspect. Tenderness over and below the patella was also noted and all motions were painful. This condition remained unchanged for two weeks with the exception that the swelling increased and the pain became so severe that it was necessary to use morphine. During this period the temperature was elevated.

September 20, 1919, the patient was referred to me by Dr. Link. Examination showed a well developed boy. General condition fair. The right knee is swollen, tense, and shiny, but not very much redness. The patient is unable to move the knee and any attempt at passive motion is associated with great pain. Tenderness is most marked on inner side of knee and below the patella. Fluctuation is present over patellar tendon. The swelling extends up the lower half of the femur and tenderness is also present in this area. The x-ray plate was negative for any pathology of the femur or patella. Aspiration of the knee-joint gave only a small quantity of bloody fluid, free of pus.

September 21—Incision made on outer side of patellar ligament and about six ounces of thick pus evacuated. A smaller counter drainage incision made on inner side of ligament. The wound was washed out with salt solution and packed with sterile gauze. A diagnosis of an abscess of fat pad beneath patellar ligament was made. At this time nothing was observed as to any involvement of the patella. The following day Dakin solution was used and this was continued until October 1. The wound did not heal and examination with a probe showed denuded bone.

October 3—X-ray examination revealed an osteomyelitis of the patella (Fig. 1), the entire bone being involved.

October 4—A small, hard, painful, tender tumor appeared in the soft tissues of the lower third of the thigh. The temperature, which had been normal since operation, became 104 and associated with a hard chill. Hot applications were applied over this area and the temperature became normal on October 6. This tumor persisted for several days but finally disappeared without further treatment. It was probably a metastatic abscess.

October 11—A large sequestrum from the patella (Fig 2) was removed through the lateral incision. It was about one inch in diameter and honeycombed by the osteomyelitic process.

October 27—Wound clean and general condition of patient good.

November 17—Wound entirely healed. The treatment up to this time had been with Dakin solution. The patient had been having active mobilization during the entire time, but the motion of the knee was limited to about twenty degrees. Patient discharged home with lateral irons and advised to walk with full weight and to remove brace several times for active exercise.

January 1, 1920—Has about forty degrees flexion at knee and extension is normal. No pain.

April 7—Flexion of knee to 90 and extension to 180. No pain. No shortening of leg. Brace has not been worn for three weeks. Child is helping about the farm and has not any disability except loss of flexion.

X-ray at this date shows the patella to be a thin plate of bone (Fig. 3).

The interesting features of this case are:

1. Primary hematogenous osteomyelitis of patella, which is rare, following a slight injury.

2. The joint cavity of the knee was not at any time involved. This confirms the well-known clinical observation that a pyogenic osteomyelitis rarely involves the neighboring joints.

3. Good function end-result, although a greater part of the patella was destroyed by the infectious process.

ON COALITIO CALCANEO-NAVICULARIS.*

BY PROF. DR. SLOMANN, COPENHAGEN.

The first suggestion I received for the study which I shall here have the honor of submitting to you, was on examining a patient who was admitted into my private clinic in February, 1916, suffering with a considerable deformity of the foot.

* Lecture given at the meeting of the Scandinavian Orthopedic Association at Copenhagen in May, 1920.

The patient was a young man of sixteen whose father stated that nothing abnormal had been noticed about the feet until the boy was four years of age. Since that time the deformity in his right foot has steadily increased; and though he did not suffer severe pain in the foot he walked badly and was very quickly tired. An examination disclosed flat-foot in both feet; but while in the left it was a case of ordinary planovalgus deformity with slight contracture of the triceps and a moderate restriction of movement, the right foot, which you see in the illustration Figure 1, was of monstrous shape, short and enormously broad, with convex rocker-shaped plantar and convex medial edge (Fig. 2). The heel and tarsus rest on the ground; but from here, the first metatarsal bone tips upward at the medial side of the foot, and only the point of the downward bent great toe again reaches the ground. The second toe lies over the first, which is deviated in valgus, so that the former is not visible from the planta. The muscles on the crus and the small muscles of the foot all seem to be in fairly good condition. Both the triceps and the dorsal-flexors are contracted; the movement in the talo-crural joint is small, only 20° to 30° in all, and the rotatory movements, the pro- and supination are as good as annihilated. The right leg is about $1\frac{1}{2}$ cm. shorter than the left, measured from the spina to the internal malleolus. The Röntgen examination of this foot now reveals the most peculiar circumstance, that the os naviculare at its most lateral portion unites completely with the proc. ant. calcanei, is coalesced with the calcaneus in osseous coalition.

This condition is very distinctly observable in the dorso-plantar x-ray (Fig. 3), where the front limit for this os calcaneo-naviculare forms a beautiful S-shaped curved line, which is divided into facets for the cuneiform and cuboid, while behind, the navicular section shows a greatly diminished articular surface for the reception of the strikingly small caput tali. Among other peculiarities of the skeleton of this foot may be mentioned the diminutiveness (shortness from front to back) of the os cuboideum which does not seem much longer than the first cuneiform; the complete depression of the caput tali, which together with os naviculare lies quite at the medial side of the proc. ant. calcanei instead of above the same, whereby the great width of the foot is produced, (and finally as a certainly accidental combination the presence of an independent epiphyseal nucleus in the tuberositas Vti). In the illustration (Fig. 4) showing a side view of the foot, the coalition is seen in a typical way, which will be repeatedly found in all cases of this sort, namely as a huge mass of bone, or bone-bridge, which from the front portion of the calcaneus stretches up-

Fig. 1.

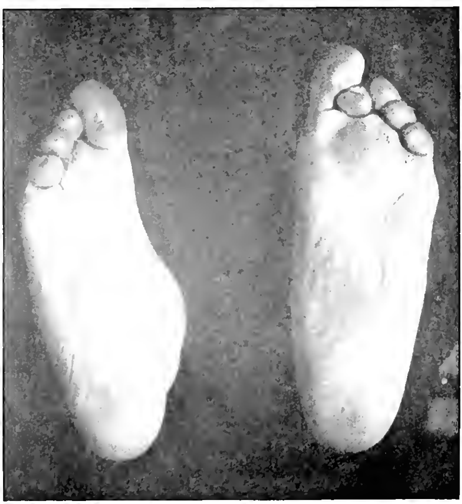

Fig. 2.

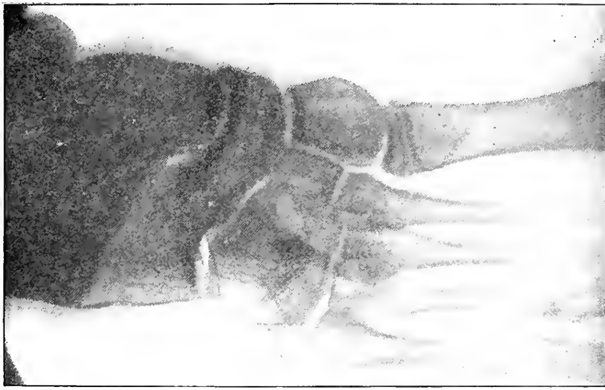

FIG. 3.

FIG. 4.

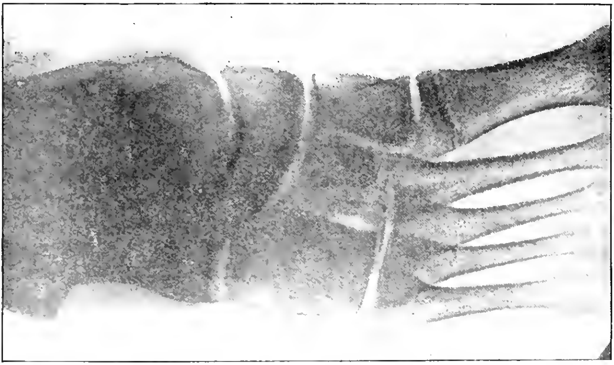

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

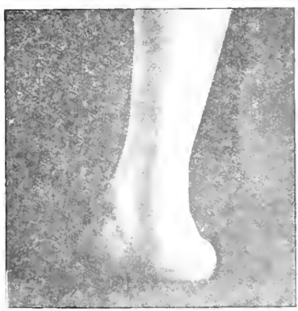

FIG. 9.

ward and forward and becomes one with the naviculare; transversely through this portion can be discerned the division of the joint between the latter and the here almost completely downward directed caput tali, the articular surface of which seems, for a great part, to rest on the bone bridge. Unfortunately in this case no side view of the left foot is obtained. Viewed from above, the skeleton of this foot does

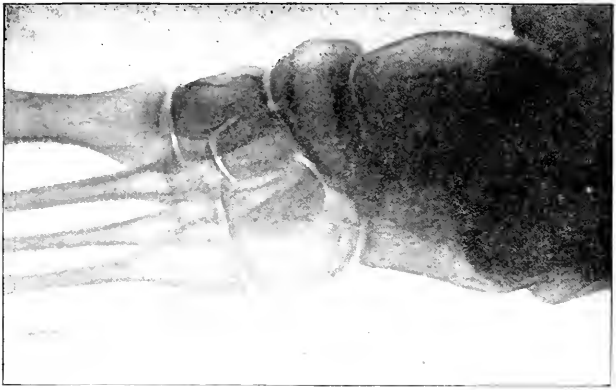

FIG. 10.

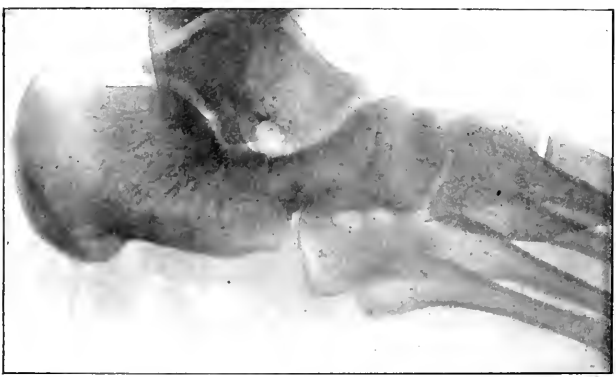

Fig. 12.

not appear to reveal anything particularly abnormal beyond the usual attributes of the flat-foot.

It is consequently clear that, though the deformity was not observed until the boy was four years old, there evidently was a congenital abnormal formation in the skeleton of the foot; and it so happened, that I was already acquainted with this kind of abnormality. In Langenbech's *Arch. f. Klin. Chir.*, Vol. 25, 1880, I had, several years previously, come across two statements by Dr. Holl, at that time Demonstrator of Anatomy at Vienna, in which he described two cases of coalition or fusion between the calcaneus and the naviculare, in just the same manner as that here described. The first case involved only an anatomical preparation of the talus, calcaneus and naviculare from one foot of an adult; but even from that preparation Dr. Holl draws the conclusion that the foot has been a very pronounced case of flat-foot, and that this deformity or, more correctly, the cause of this was congenital; in the second case he found, on dissecting an infant a few days old, with flat-foot in both feet,—exactly in the same manner as I have described above, the calcaneus and naviculare directly uniting while forming a continuous mass of cartilage. Finally he mentions a similar instance described by Zuckerkandl, likewise from the Anatomical Institute at Vienna. Here, however, the connection between the two bones was not bone,

but was composed of an exceedingly firm, hard, fibrous tissue, over the front of which the cartilaginous covering from the front surface of the os naviculare fused directly with the front surface of the calcaneus, where that bone articulates with the cuboid. The fibrous tissue in question contained, posteriorly, a small wedge-shaped bony substance (5 x 5 mm.),—undoubtedly, I should say, an "os calcaneum secundarium."

The congenital abnormalities in the formation of the tarsus, of which the coalition here treated is a particular form, must as a rule be traced back to the extra bones in the foot-skeleton, the so-called tarsalia, *i.e.*, rudimentary bone corpuscles preformed in cartilage, which are invariable in their localisation, but very variable in regard to development, shape, and independence in relation to the typical neighboring bones, and which have been made the subject of thorough research by Wenzel, Gruber and subsequently by Pfitzner. Pfitzner's monumental treatise, constructed on a work of colossal anatomical detail: "Die Variationen im Aufbau des Fuss-Skeletts," in *Morphologische Arbeiten*, Vol. VI, 1896, is undoubtedly the most important work of reference on this subject; and also with regard to the point in question here, the information he gives is both copious and thorough. I shall briefly state the quintessence of it.

At that point of the tarsus skeleton where the proc. ant. calcanei, the cuboideum, the naviculare and the caput tali meet, without, however, all coming into direct touch, is to be found, with careful dissection, in a certain number of cases, a little bone of irregular shape, the so-called calcaneus secundarius: a tarsale which, previous to Pfitzner, Stieda (in 1869) and Gruber had already pointed out. Pfitzner found it on examination of 840 foot skeletons, which he had most minutely prepared, in nine feet as independent bone, *i.e.*, in about 1% of the cases, so that it is not so exceedingly rare. That it is so very rarely found in Röntgen examinations of the foot is due, I should say, to the projection in which the photos are generally taken, as, when the exposure is not particularly adapted to the position of this bone, it is covered by the neighboring bones. Like all the genuine rudimentary tarsalia, it appears symmetrically; in so far as when it is present, it always seems to be present in both feet; but the symmetry is veiled inasmuch as its size, independence, etc., can be very different in the two feet. Its size can vary greatly; Pfitzner found the largest specimen of it, measuring 15 x 8 x 5 mm., in an Egyptian mummy. On such specimens can be pointed out four surfaces facing the four bones mentioned, among which the calc. sec. is inserted. The surfaces facing the

talus and cuboideum are articular surfaces, while those facing the proc. ant. calcanei and the naviculare are attached to these bones by a fibrous tissue (identical with the calcaneo-navicular segment of the Lig. bifurcatum S. ypsiloides). If the calcaneus secundarius is strongly developed, it, in this way, forms a bridge between the calcaneus and naviculare, and if now it follows the tendency of the inconstant tarsalia to fuse with the constant neighboring bones, it may show itself either, as is most usual, as a protuberance on the calcaneus, or as a protuberance on the naviculare, *or finally, if it attaches itself closely to both, as a coalitio calcaneo-navicularis.**

Of such coalitions Pfitzner has himself described 15, while he has collected 38 from the literature on the subject. The coalition may have the character of a complete synostosis; more frequently is found, between the two bones, a minimal, irregular shaped fissure filled with connective tissue; lastly, the connection may form a tight articulation.

After the number of cases of such coalitio calcaneo-navicularis, over fifty, which, as stated, Pfitzner has at his disposal and which, indeed, all are found by anatomical preparation, one might now expect that, with the era of Röntgen examination, new life would have been infused into the study of this abnormality, as now the clinical observation is in a position to make its contribution thereto. Nevertheless, this has hitherto been so far from the case, that I cannot recollect ever having seen an instance of this kind referred to or mentioned in modern orthopædic literature. The only such place I have found the abnormality mentioned is in Joachimsthal's large "Handbuch der Orthopädischen Chirurgie," where Joachimsthal himself, in the section on the ætiology of flat-foot (Vol. II, p. 668), mentions Holl's observation, but erroneously reports it as though it was concerned with a coalescence of the Calcaneus *and Talus*. It is all the more remarkable, that since my first case, described above, I have myself, in a very modest sphere of activity, met with three† cases more of the same kind;—cases which like the first, I have been able to study only through the most beautiful, but in comparison with the direct anatomical examination, highly imperfect method of the Röntgen examination; but which nevertheless may be acknowledged as unquestionable coalitiones calcaneo-naviculares. I shall show some illustrations of these cases.

My Case No. 2 was a boy of thirteen, who only in the last six

* According to Pfitzner, every such coalitio will involve also a cuboideum secundarium, a hypothetical tarsale, never observed as independent bone; a question which, however, would lead us too far if entered upon here.

† And now four.

FIG. 13.

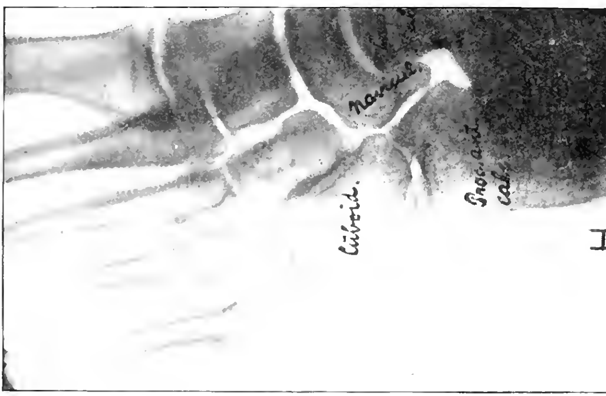

FIG. 14.

Fig. 15.

Fig. 16.

Fig. 17.

months had had pains in the left foot and crus, particularly after walking for some time. The left foot was a rather strongly applanated, but in no way remarkably deformed flat foot. The only thing remarkable, considering his age, was the unusual rigidity of the foot, which did not disappear with lying in bed and the application of cataplasms. The Röntgen photo (Fig. 5) shows an indubitable, though perhaps not yet completely ossified coalition, which also in the lateral view (Fig. 6) stands out very characteristically. The talus presents nothing particularly remarkable nor does the cuboideum. Especially interesting, from a clinical point of view, is the lateral picture of the quite normal right foot (Fig. 7). The remarkably strong and beautifully shaped prolongation, which from the proc. ant. calcanei extends up to the naviculare, represents very probably an os calcaneum secundarium fused with the calcaneus.

The third case has to do with a young girl of seventeen who, at the age of one year was pronounced to have flat-foot. At the age of ten, considerable pain and aching were perceptible, though only in the right foot, but which during the last few years had, if anything, diminished slightly. The shape of the foot, however, now became so unsightly that she took advice regarding it. Whilst the left foot is only a moderately applanated, flexible flat foot, the right, as you see (Fig. 8) is completely applanated and strongly valgus-deformed (Fig. 9), of a somewhat monstrous appearance, and besides completely stiff. There is a partial atrophy of the calf and, as in my first case, a shortening of the extremity of 1½ cm. The Röntgen photos show the typical coalitio (Fig. 10) and here, just as in Case 1, the deformity of the talus and cuboideum is rather considerable, though not so considerable as in that case (Fig. 11). In the lateral aspect (Fig. 11) the bridge from the proc. ant. calcanei to the navicularis is very striking with its conspicuous length (a circumstance which Holl also mentions in his preparation). The picture of the left foot seen from above, shows a fairly normal condition. In the lateral view (Fig. 12) is to be seen an interesting parallel to the normal foot in the foregoing case, an approach between the proc. ant. calcanei and the naviculare; but here it is the naviculare, which extends a curious prolongation downward and backwards, a prolongation which must be assumed to represent the calcaneum secundarium, here coalesced with the naviculare alone.

My fourth case I ultimately found in a gentleman of 59, who from his infancy had had considerable flat-foot troubles in both his now greatly deformed and perfectly stiff feet, severer, however, in the more seriously deformed left, which had once been treated with plaster of

Paris bandages. This case presents a special feature of interest inasmuch as it is, also as regards the anatomical abnormality, bilateral. As regards the left foot, the coalition is indeed typical both in the lateral aspect and in the dorso-plantar (Fig. 13). In the latter, however, a small irregular fissure can be faintly discerned on the plate which, nearly in the longitudinal axis of the foot, forms a boundary between the naviculare and the proc. ant. calcanei and which, I take it, is undoubtedly filled with a short, tight connective tissue which unites the bones immovably with each other. The "S" shaped articular surface in front is quite unbroken. As regards the right foot, the lateral aspect, at any rate, reminds one forcibly of that produced by the typical coalition. In the dorso-plantar picture (Fig. 14) is seen a broad contact between the naviculare and the proc. ant. calcanei, whereby the cuboideum is pushed far away from the caput tali, but between the two former bones, however, there is very distinctly seen so broad a fissure with so smooth an edge, that it evidently points more to an articulation than to a fibrous coalition. If one, however, observes the shapes of the two bones which here, indeed, are just the same as in the typical cases of coalition, and when one recollects *that under normal anatomical conditions the naviculare and the proc. ant. calcanei do not come into direct touch at all with each other*, it is then clear that here the conditions in the right and left foot are so closely related, that the case must be regarded as bilateral.

Of my cases, therefore, two are in the right, one in the left,* and one in both feet. Pfitzner finds on collocating twenty-one cases, two right, four left (of which one is with articulation), and fifteen in both feet (of which two are with articulation in both feet, one with articulation in the right foot). The abnormality, therefore, does not appear to show any particular preference for the right or left foot; according to the anatomical investigations, the cases are by a large majority bilateral. As you have seen, all my cases have had to do with severe flat-foot deformities, and flat-foot, both in regard to the degree of deformity as well as to the clinical symptoms, has been most severe in the foot where the anatomical abnormality was present or most pronounced. (In Case No. 2, that of a young boy of thirteen, the other foot was still normal both in build and function.) This coincidence cannot be accidental, any more than that, in spite of the most rigid attention, I have never met with the coalition as an accidental discovery in any of the very numerous cases where the foot skeletons of normally shaped and functioning feet have been examined with

* My fifth case, observed later, is also a left-foot case.

x-rays. Holl also, as mentioned, places the abnormality in close relation with a strongly pronounced flat foot deformity, which was present in his two cases. All the more remarkable is it then that Pfitzner flatly denies such a relation. His most pronounced case of coalition was, he says, found in a particularly well arched foot, and on the whole, in his 15 cases, he only twice found flat foot "mittleren Grades."

I am not in a position to give any explanation of this disagreement; the deformities which were present in my cases could not fail to be seen even by an anatomist, and the relation of the coalition to the deformity is, in my opinion, unquestionable.

It is, I take it, the manner in which the anterior component of the body weight, acting downward and forward in the corpus tali, is transmitted through the caput tali to the naviculare *and then stopped up by the coalition,* is transferred directly to the foremost and innermost point of the calcaneus (instead of, as in normal conditions, to be transmitted from the naviculare forward through the cuneiforme I to the metatarsale I), which rotates the calcaneus inward and lays its foremost part down flat against the ground. My Case No. 1, in which the back end of the metatarsale I was depressed and the front end tipped upward, appears to me in this respect to be particularly instructive.

In the performance of Chopart's operation, the presence of the abnormality will form an apparently insurmountable and, for those who do not know it, an incomprehensible obstacle.

I cannot conclude this statement without saying a few words as to *the treatment* of these cases. I have in the three cases, where young persons of 13, 16 and 17 years of age were concerned, treated them just as I treat all other cases of flat foot deformities at that age, with moulding and fixing in plaster of Paris in corrected or over-corrected shape and position; after that, working up of the mobility and muscular power, corrective night bandages and flat-foot boots (or Whitman's metal soles in the boots). The primary result has been fairly satisfactory. While my first, monstrous case could only be corrected to a certain extent, I was in this respect very successful with the other two patients. I can show you the result in Case No. 3, that of the 17-year-old girl, whose foot, before treatment, is shown, laterally, in Figure 8. Figure 15 shows the change that took place after treatment (the scar is due to a transplanting of the tibialis anticus from the dorsal side of the foot, where it was inserted, down to the plantar side of the basis metatarsi I). Figure 9 shows a posterior view of the

foot before treatment, and Figure 16 the same view after treatment. The good result, both as regards shape and function, in this case, has now lasted for a year; but I must say that I myself have not much confidence in the durability of the results of this method; for the deforming factor which I have mentioned above, the body weight's direct downward pressure on the proc. ant. calcanei, of course, continues to exist. I have also considered the possibility of a surgical operation for removing the coalition, that is to say a resection of the abnormal bridge between the calcaneus and naviculare. The reason why I have hitherto refrained from performing this operation is that the consequences of the looseness in the tarsus caused thereby are difficult to overlook; for of course such a resection cannot create a normal condition between the two bones: the normal ligamentous connection is wanting; and the tarsus, we must suppose, is also the seat of other ligamentous and muscular deficiencies which are not removed by the coalition ceasing to exist. Should, however, such a case come to me with a severe relapse after the first more conservative treatment, and with great subjective difficulties, I would, nevertheless, seriously consider such an operation.

Since the conclusion of the above article, I have had the opportunity of seeing still another case of the same kind.

N. L., a bright, healthy little girl of ten, was admitted into my clinic in August, 1920. Her left foot was always disposed to be tender, though her gait was natural and she was a good walker. Ten or twelve days ago when, after a drive, she attempted to walk on alighting from the motor-car, she suddenly felt severe pains in that foot, which also, on her arrival home, appeared swollen, and the pains increased in spite of rest and massage. When she was examined by me the swelling had disappeared, but there was a distinct tenderness around the foot, corresponding to Chopart's joint line, most severe on the lateral side and in the planta. The shape and arch of the foot was perfectly normal—it was, if anything, unusually well formed—but she refused to stand on it on account of the pain. Röntgen plate showed a typical coalitio calcaneo-navicularis (Fig. 17). The right foot was of the same good shape and entirely free from pain; Röntgen photo here showed a perfectly normal condition.

There was a reduction in circumference of 1 cm. of the left leg, both about the crus and femur, but no shortening of the limb.

After the foot had been set in plaster of Paris for a week and had received later massage treatment, and a support for the instep fitted into the boot, the symptoms for the present have disappeared.

The particular feature of interest in this case lies, for the one part, in the still well preserved shape of the foot; and for the other, in the functional insufficiency connected with the abnormally constructed foot skeleton, which, nevertheless, even now is conspicuous, and which, if the instep is not mechanically supported, will undoubtedly lead to serious functional disturbances and flat-foot deformity.

BONE SARCOMA. AN ANALYSIS OF THE CASES ADMITTED TO THE MASSACHUSETTS GENERAL AND COLLIS P. HUNTINGTON MEMORIAL HOSPITALS FROM JANUARY 1, 1911, to JANUARY 1, 1921.*

REPORTED BY ROBERT B. GREENOUGH, M.D., CHANNING C. SIMMONS, M.D., AND TORR W. HARMER, M.D., BOSTON, MASSACHUSETTS.

In view of the interest in this subject aroused by Dr. E. A. Codman's move to organize a registry of living cases, and with due regard to the lack of coördination of opinion upon the pathological and clinical aspects of bone sarcoma, the writers have collected and studied the cases of sarcoma of bone from the records of the Massachusetts General Hospital and the Collis P. Huntington Memorial Hospital for a ten-year period ending January 1, 1921.

The records of both hospitals were examined, and all cases entered with a provisional diagnosis of bone sarcoma were examined, 148 in number, together with 27 cases of bone-cyst, osteitis-fibrosa, and epulis, which were desired for comparative study—a total of 175 cases examined.

Perhaps the most surprising fact of the whole study is that out of 148 cases sent in as possible bone sarcoma only 66 could be considered in fact to be cases of malignant new-growth of bony origin; the remaining 82 cases proving on more detailed study to be metastatic tumors of bone (29 cases), sarcoma primary in the soft parts (28 cases),

* Presented at a meeting of the American Orthopedic Association, Boston, Massachusetts, June 2, 1921.

inflammatory conditions (11 cases), or tumors of a non-sarcomatous type (14 cases).

Cases of sarcoma of antrum, ethmoid and accessory nasal sinuses, eight in number, are included in the group of cases of saeoma of the soft parts. Although bone involvement occurs early in these regions, no evidence could be obtained to justify the idea that these were tumors of bone origin or included osteogenic tissue.

Of the 66 tumors of bony origin, 15 were probably cases of bone sarcoma, but as no operation was performed and pathological proof of the nature of the disease was not available, these cases have been discarded as of no value in this investigation. Six cases of probable multiple myeloma were also omitted from consideration for lack of pathological evidence to support the diagnosis and two cases of a true bone sarcoma could not be traced after discharge from the hospital and are, therefore, eliminated as inconclusive. Taking these 23 cases out, the remaining 43 cases have been studied to supply the data for this report.

While more elaborate classifications of bone sarcoma have been offered, notably by Borst, Bloodgood and Buerger, the classification given by Ewing in his book "Neoplastic Diseases" has been followed in this investigation. Under Ewing's classification, the 43 cases studied may be grouped as follows:

1.	Osteogenic Sarcoma	27	cases
2.	Benign Giant-cell Tumors	12	"
3.	Myeloma	3	"
4.	Angio-endothelioma	1	case
	TOTAL	43	cases

It will be observed that the largest group, 27 cases, falls under the general classification of osteogenic sarcoma. Ewing distinguishes three types under the heading: (a) sclerosing; (b) telangiectatic; (c) fibro-cellular (chiefly periosteal).

We have one example of the sclerosing type, none of the telangiectatic variety, and 26 of the fibro-cellular group.

The difficulty of classification of these tumors appears to be due chiefly to the attempt to apply to bone sarcoma the distinctions in regard to histology which are commonly employed in the study and nomenclature of tumors and diseases of other tissues. Thus spindle-cell sarcoma, large round-cell and small round-cell sarcoma, fibro-sarcoma, myxo-sarcoma, chondro-sarcoma, osteo-sarcoma, osteoid-sarcoma, and combinations of these terms, such as osteo-chrondro-sar-

coma, fibro-myxo-sarcoma, are all terms which have been used rather indiscriminately by surgeons and by pathologists with the effect of clouding the issue rather than of contributing to our knowledge of the disease. The attempt to distinguish also between central or medullary types of sarcoma and those of periosteal origin has also added to the difficulties of the subject, and although certain forms of tumor, such as the "benign giant cell tumor," are essentially central in origin when they occur in the long bones, in other situations they may be situated outside the bone and attributable only to a periosteal origin, as in their commonest manifestation, the true epulis of the alveolar process of the jaw.

As a result of our study of the pathological material of this series of cases, together with the x-ray plates, and with the assistance and advice which we gratefully acknowledge to have received from Dr. James Homer Wright, Dr. James Ewing, Dr. Henry F. Hartwell, Dr. E. A. Codman, and Dr. George W. Holmes, we have been driven to the following conclusions:

The osteogenic sarcomatous tumors which arise in bone substance are produced by a tumor growth of the essential fibrous tissue made up of spindle cells, which is the accepted progenitor of the bone-forming tissues of the body. These cells are capable of differentiation into bone, osteoid tissue, cartilage, myxomatous tissue, and fibrous tissue, as well as into a more succulent and less differentiated mass of pleomorphic cells of irregular form and function, and of high malignancy. In cases of the pleo-morphic and highly malignant type, giant cells of tumor origin similar to the epithelial giant cells of cancer, and containing two, or occasionally more, large, irregular nuclei often in mitosis, are sometimes found. These tumor giant cells are to be distinguished sharply from the typical foreign-body cells of endothelial origin (Mallory; Barrie) which are encountered so frequently in all bone diseases, benign and malignant, and which are of practically no significance from the tumor point of view, however much they may impress themselves upon the observer in the microscopic sections of the tissue, as in the miscalled "giant cell sarcoma" of the epulis type, which is, in fact, as it has been abundantly proved by Bloodgood and others, a non-malignant and non-metastasizing tumor.

With this preliminary statement we may proceed to an analysis of the four types of bone sarcoma which were available to us for study:

OSTEOGENIC SARCOMA.

Twenty-seven cases. The ages at which tumors of this character occur cover a considerable period of life. By decades there were:

1 case from 1 to 10 years
9 cases from 10 to 20 years
7 cases from 20 to 30 years
4 cases from 30 to 40 years
6 cases over 40 years

The greatest incidence is thus seen to be between 10 and 30, and in earlier and later ages the disease is less common, although it does occasionally occur.

In any study of malignant disease the duration of the symptoms before radical operative treatment is afforded is of the utmost significance. In this series the duration of symptoms was less than twelve months in all but three cases; from one to three months, eight cases; three to six months, eight cases; six to twelve months, eight cases; over twelve months, two cases, and doubtful, one case. This must be admitted to be a fairly prompt application of radical measures, but the results appear to indicate that the delay in procuring radical treatment is still too long.

Thirteen cases gave pain as the first symptom, and four stated that pain and swelling began together. Nine cases noticed a swelling tumor as the first symptom, and in one case a spontaneous fracture was the first symptom to draw attention to the condition. It is significant, apparently, that pain may precede the obvious development of the tumor for a considerable period of time. In 10 of the 27 cases a positive and definite history of local trauma of some sort was given as a matter of significance in the history, and usually at a period but slightly prior to the onset of symptoms. We believe it possible that the element of trauma may well enter into the question of the etiology of these tumors.

Twenty-two cases in this group involved the long bones—femur 10, tibia 9, humerus 2, fibula 1. Two involved the lower jaw, one the spine, one the pelvis, and one the ribs.

Operation.

Nineteen amputations were performed when the disease was in the long bones, and an amputation was a possibility, and in two cases amputation was advised and refused.

One case, a boy of twelve, died within twenty-four hours of operation as a result of shock and hemorrhage. This was a patient with a large tumor springing from the base of the skull, filling the ethmoid and antral region and infiltrating the upper jaw, so that it extended into the zygomatic fossa. The tumor was of osteogenic fibro-myxomatous type, and was believed to be one of low-grade malignancy, but its local extent involved too severe an operation for the resistance of the patient. This was the only operative death.

In 15 of the 27 cases an exploratory incision was made to procure tissue for pathological examination. In four cases the records were not clear upon this point, and in eight cases no exploration was made. It is suggestive that in two of the five successful cases exploratory incision into the tumor was made at some time prior to the radical operation, and in one other case an incision was made into the tumor, the diagnosis established, and the amputation at once performed. It does not seem unreasonable, therefore, to maintain that an exploratory incision diminishes but little, if at all, the patient's chances of cure by radical operation. We would not be understood to advocate exploration as a routine measure, but if the diagnosis is uncertain after x-rays and other methods of examination have been employed, a carefully conducted exploration, making use of formalin or carbolic packs, or the actual cautery, and discarding the instruments and dry goods used, before proceeding to immediate amputation, seems to us to be preferred to the misfortunes of either a needless amputation of an extremity, or of delay until the condition is beyond operative relief.

Non-operative Treatment.

In those cases which refused radical treatment by excision or amputation, and in a number of cases in which the radical operation was performed, treatment by x-ray or with Coley serum was employed as a curative or prophylactic measure. In no case of this series was radium treatment given.

Coley serum was used systematically in three of these cases by Dr. Harmer, and with no obvious benefit; and in one other case Coley treatment was given after operation by the physician in charge of the patient, at his home. None of these four patients lived more than ten months after operation.

So far as the non-operative methods of treatment of osteogenic sarcoma go, this series gives but little information.

Pathology.

The most interesting feature of these tumors, apart from the seriousness of the disease and the small percentage of cases which are relieved by operation, is the gross and microscopic pathology of the tumors.

The routine pathological examination of the material of the two hospitals was under the direction of Drs. J. Homer Wright, W. F. Whitney and H. F. Hartwell, and their reports have been taken in extenso, but the slides have all been re-studied and in several cases new sections have been cut and stained. All of the material has been reviewed by Dr. Wright.

As has already been stated, it is our belief that a differentiation of these tumors into many groups, according to the various cell types or tissue types observed, tends somwhat to confuse the issue. The cell characteristics of a high degree of malignancy in other tumors are well recognized and depend upon such elements as irregular and distorted nuclei, hyperchromatism, marked variation in the size, shape, and staining qualities of the cells and the occurrence of "tumor" giant-cells—cells containing a relatively small number of irregular nuclei, irregularly placed in the cell, and almost always readily distinguished from the huge typical "foreign-body" giant cells that occur in bone tumors and complicate the picture. The essential tissue from which these tumors are derived is the fibrous tissue, made up of spindle cells (fibro-blasts) which is the progenitor of bone. These cells are capable of differentiation into cells of many forms, and of producing intercellular substance varying from fibrous tissue through myxomatous-like substances to osteoid tissue, cartilage, and bone. This differentiation is a fundamental characteristic of these cells and although often incomplete and atypical, almost invariably can be recognized even in the most irregular and rapidly growing types of tumor in which pleo-morphic growth is most conspicuous.

Thus, in this series of 27 cases, fibrous tissue cells and substance could be identified in every case. In 24 cases osteoid tissue could be recognized. In 11 of the above 14, cartilage was present, and in five cases myxomatous tissue was found, usually but not invariably accompanying cartilage. In three of these cases large "epulis" type foreign-body giant-cells were a conspicuous feature of the tumor, but were accompanied by osteogenic tumor tissue of such a degree of active growth that the failure to obtain a cure in any of these three cases was not difficult to understand.

Reference will be made to these facts in the discussion of the end-results, but it is sufficient here to say that the character of the cell growth in form, size, shape, and regularity, as shown by the microscopic examination rather than the intercellular substance which may be differentiated from them, appears to us to be the important fact in determining prognosis.

Of the three types of osteogenic sarcoma distinguished by Ewing, two are here represented (Case 123). There was one example of the "sclerosing" type of osteogenic sarcoma. This was a woman of thirty-four who for twelve months had had a fusiform swelling of the thigh just above the knee, following an injury. X-rays showed a dense mass of cortical bone in the lower end of the shaft of the femur and the radiating lines of bone trabeculae outside the cortex characteristic of periosteal sarcoma. An exploratory incision was made and the leg was amputated. The specimen showed a dense new growth of bone, the cortex of the femur being 2 cm. thick, and the interstices of the bone trabeculae filled with tumor tissue of a fibro-osteo-sarcoma type. The picture was one of a high degree of differentiation in the way of bone formation and of low malignancy. There were few mitoses. The patient is well at the present time—three years after operation.

Of the telangiectatic type (Ewing) we have no examples, and the remaining 26 cases fall into the fibro-cellular osteogenic sarcoma group. It is probable that some of these tumors are of endosteal rather than periosteal origin. At any rate, fibro-cellular osteogenic sarcoma is the safest and most accurate term to use.

X-ray.

While the x-ray is, without doubt, the most valuable method we possess for arriving at an idea of the structural changes of all bone lesions, we must not forget that its lights and shadows must be interpreted with a full knowledge of the anatomical and physical conditions, and especially of the density or atomic weights of the varying substances.

With the x-ray we can determine the absence of bone where bone should be, and its presence where it should not be, but osteoid tissue and cartilage throw no such shadow as bone, and their presence is not so readily demonstrated. Again, the absence of normal bone shadow may be due to a great number of pathological processes—developmental, inflammatory, and constitutional—as well as to a large number of malignant tumors of which bone sarcoma is only one va-

riety. It is a suggestive fact that in collecting 27 cases of osteogenic sarcoma, 29 cases of metastatic tumors of bone had to be eliminated as well as 28 cases of sarcoma originating in the soft parts, and subsequently invading the bone.

Under the circumstances it is perhaps not unnatural that the x-ray is not always an absolute method of diagnosis. The arbitrary distinction between central (or medullary) and periosteal sarcoma is also a cause for difficulty in x-ray interpretation, although the benign giant cell tumor has certain pronounced and positive characteristics by which its x-ray picture can often be identified.

The x-ray plate of an osteogenic sarcoma is not always characteristic. A well-defined tumor of the cortex of one of the long bones showing increased density within and without the marrow cavity, radiating lines of new bone formation perpendicular and external to the cortex, elevation of the periosteum at the edge of the tumor, and with areas of bone destruction, is the generally recognized picture of typical periosteal osteogenic sarcoma. Fourteen of this series of 28 cases were of this variety. In two cases a process of bone destruction with but little new bone formation was shown in the x-ray (easily mistaken for metastatic cancer or osteomyelitis), and in four cases the tumor was apparently central in origin, and no obvious new growth of bone, beyond the cortex, could be made out. The resemblance to a giant cell tumor in these cases is very marked. In the other seven cases the x-ray plates were inconclusive or were not available for reëxamination.

In general it can be said that in its earliest stages the x-ray of an osteogenic tumor shows an area of increased density either within or without the bone. As time goes on and the normal bone is absorbed and replaced by less differentiated cells, defects in the bone substance appear, their degree of emptiness depending upon the amount of density of the tumor tissue. At the same time a distortion of the external surface of the bone appears, again depending upon the density of tumor growth outside the cortex. It is easy to see that any metastatic tumor, whether derived from a hypernephroma, a neuro-blastoma or a cancer of the prostate or of the breast, may simulate this picture very closely, and although the diffuse growth of new bone in spicules perpendicular to the cortex is only rarely duplicated in any other condition than osteogenic sarcoma, it is not by any means a constant phenomenon of that disease, and its absence is not sufficient to rule out that condition.

End-Results.

In other publications dealing with the end-results of operations for cancer of the breast and cancer of the tongue and mouth,* the writers have attempted to establish a standard method of reporting cases in order that the results of different clinics may fairly be compared. A tabular statement of these cases on this standard form is as follows:

OSTEOGENIC SARCOMA.

A.	Total cases entered hospitals	56
B.	Re-entries	12
C.	Recurrence from previous operations (not eliminated in this series)	0
D.	Cases without pathological report or evidence to support diagnosis	0
E.	Untraced	2
F.	Inconclusive (arbitrary three-year limit not attained)	2
G.	Remainder, traced	40
H.	Radical operations { Amputation .... 17 / Excision or resection 6 }	23
I.	Palliative operations (explorations only)	2
J.	No operation	15
K.	Operative deaths	1
L.	Operative mortality	4%
M.	Operability percentage—all cases	60%
N.	Operability percentage—radical operations	58%
O.	Number of cases alive and well (3 years)	2
P.	Number of cases died without recurrence (3 years+)	1
Q.	Total 3 year "cures" by radical operation (Cases Nos. 12, 28, 44)	3
R.	Total 3 year "cures" all operations	3
S.	Percentage of "cures" by radical operation	13%
T.	Percentage of "cures" by all operations	12%

Thus of the 27 cases of osteogenic sarcoma we must eliminate two which are alive and well at periods of twelve and fifteen months after operation, on the ground that they have not reached the arbitrary three-year limit. Of the remaining 25 cases, 23 had radical operations performed in the hope of cure, and two refused operation. Seventeen were amputations and six were excisions or resections, as of the jaw, ribs, pelvis, spine, etc. The 23 radical operations yielded one operative death (4.3%), and three cases free from disease at the expiration of the three-year limit. We hesitate to call them cures. This gives a percentage of success by radical operation of 13 per cent.

The three successful cases are as follows:

CASE 12. Aged 34. Twelve months' duration. Femur. X-ray: periosteal trabeculae and dense tumor. Sclerosing type osteogenic sarcoma. Amputation. Well. Three years.

CASE 28. Aged 24. Six months' duration. Tibia. X-ray: "periosteal" sarcoma. Osteogenic-fibro-osteo-myxo-sarcoma. Ampu-

* End-results in cancer cases. Greenough and Simmons. Boston Medical and Surgical Journal, Vol. 185, No. 9, pp. 258-261, Sept. 1, 1921.

tation. Remained free from disease and was examined by physician in five years, but died of acute influenza-pneumonia during the epidemic, five and a half years after operation.

CASE 44. Aged 65. Two and a half months' duration. Jaw. X-ray not recorded. Osteogenic-fibro-osteo-sarcoma, central and peripheral. Resection. Well, three years.

The remaining 22 cases are all dead or when last reported had positive recurrence of the disease. The average duration of life after operation in these cases was eleven and a half months, the figures varying from immediate post-operative death to three and a quarter years. In no case did a recurrence develop at a period of time greater than three years after operation. The most frequent situation for recurrence was in the lung—the figures for 17 cases giving: lung alone, 9; lung and local, 3; lung and spine, 1; spine, 2; abdomen, 1; local alone, 1.

This completes the analysis of the cases of osteogenic sarcoma. A few cases (13 per cent.) have been successfully treated with radical operation, but the vast majority develop lung metastases and die within a short period.

BENIGN GIANT CELL SARCOMA.

The term "sarcoma" is a very doubtful one to apply to this group of tumors, and it should undoubtedly be taken from the sarcoma class and given another title, as suggested by Bloodgood and others. Benign giant cell tumor is, perhaps, as good as any.

Of this group we have 12 cases, and of these cases 11 are alive at periods of three months to eight years after operation, and there was one death following operation. This stands out in clear contrast to the group of osteogenic tumors.

Age.

The ages of these cases varied from twenty-eight months to sixty-eight years, with the following distribution in decades:

3 cases from 1 to 10 years
3 cases from 10 to 20 years
1 case from 20 to 30 years
2 cases from 30 to 40 years
2 cases from 40 to 50 years
0 cases from 50 to 60 years
1 case from 60 to 70 years

The incidence in youth and young adults is not so striking in this series as in other reported cases.

Symptoms.

The duration of symptoms varied from two days to three years and averaged about twelve months. The first symptom was swelling in six cases, pain in five cases, and a spontaneous fracture in one case. There was a definite history of trauma in three cases shortly prior to the development of symptoms.

Situation.

The 12 tumors of the benign giant cell type were widely distributed: Eight involved the long bones, as follows: femur, 2; tibia, 2; radius, humerus, fibula, and ulna, each 1. The other four involved other bones, as follows: phalanx, 1; upper jaw, 1; lower jaw, 1, and spine, 1. Seven involved the extremities of the long bones and only one the shaft.

Operation.

The operations performed in these 12 cases varied from incision and curettage to amputation. There were three cases of amputation, two of complete resection, and seven of incision, partial excision, and curettage. There was one operative death from pneumonia, following resection of the upper jaw, in a child of two years of age, for an enormous tumor which distended the antrum, perforated the zygomatic fossa and palate and produced exophthalmos. One case in this series received treatment by the insertion of radium needles after curettage. This case is now living, with recurrence, but the disease is retrogressing. Another case of tumor of the spine had only a partial excision, followed by recurrence. This case was given Coley treatment under Dr. Harmer, for seven months, with injections directly into the tumor, which became necrotic and sloughed away. A tumor developing subsequently was excised and showed no evidence of the original growth. The patient is now well eight years after the original operation. In all but four of the twelve cases a preliminary incision for diagnosis was performed.

Pathology.

The characteristics of the benign giant cell tumor are well recognized and have been described by Bloodgood and others. The tumor is of central origin, as a rule, and effects especially the ends of the long bones, extending frequently across the epiphyseal line. It especially affects young adults, although in this series, cases of all ages have been encountered. The growth from within thins the cortex and

complete or partial fracture of the cortex may occur with spontaneous fracture (one case) or extension to the soft parts. This may be so extensive that conservative measures are impossible and amputation is the only resource, but, as a rule, more conservative treatment is possible and should be attempted.

The gross appearance of the tumor is characteristic—a dark, succulent, friable tissue fills the dilated interspaces of the bony shell. On microscopic examination this tissue is made up of fibrous tissue spindle cells of fairly constant form and character, but interspersed with large numbers of the characteristic large foreign-body giant cells which dominate the microscopic picture. The tissue is similar in every way to that of the true epulis of the gums, and is often spoken of as of the "epulis" type. We have no evidence of any metastases from tumors of this type. Occasionally, however, other elements are found in tumors of the benign giant-cell group. These are areas of osteoid tissue and cartilage sufficient in some instances to suggest a new growth of these elements. On closer consideration, however, it is realized that opportunity for the formation of new bone and for the presence of cartilage is afforded by the destructive process which thins the cortex, and the involvement of the epiphyseal line in which growing bone and cartilage are already present. We are inclined to believe that this is the explanation for the apparently new-formed bone elements occasionally but infrequently discovered in microscopic sections of benign giant cell tumors.

X-rays.

The x-ray plate of a benign giant cell tumor has certain well defined diagnostic characteristics. The tumor occupies the central part of the bone, usually at the expanded end of one of the long bones, and produces an absorption of the finer bone trabeculae, leaving clear spaces of diminished density, more or less divided into several chambers by the bony trabeculae which are sufficiently solid to resist absorption. The whole cortex becomes thinned and expanded, and in advanced cases may be fractured or perforated, and the tumor may extend into the soft parts. The tumor often extends across the epiphyseal line to the joint cartilage, but the joint was not involved in any case of this series.

The extension beyond the epiphyseal line is a point in diagnosis which distinguishes from bone cysts, which occur, as a rule, in younger children. In other respects the x-ray pictures of the two conditions are very similar. In none of our cases was there x-ray evidence of

new bone formation, although in four cases areas of osteoid tissue were recognizable in the microscopic section of the tumor. Two of these cases were tumors of the long bones involving the epiphyseal ends, in children thirteen years of age. The third was a case of spontaneous fracture, and the fourth was a tumor of the lower jaw.

Diagnosis.

The benign giant cell tumor is to be distinguished especially from the benign conditions such as bone cysts and osteitis fibrosa as well as from the osteogenic tumors. Some of the metastatic bone tumors—cancer, hypernephroma, etc.,—can also closely simulate the x-ray picture of a benign giant cell tumor, and these conditions must be recognized either by the discovery of multiple tumors or of the primary lesion, or by an exploration. Some of the more chronic inflammatory conditions—osteomyelitis, tuberculosis and syphilis—may also be confused with the benign giant cell tumor by x-ray alone, but almost always show some evidence of the new bone formation which is characteristic of the inflammatory processes. The tendency of the benign giant cell tumor to overrun the epiphysis, as well as the greater age of the patient, is an aid in excluding bone cysts, and from some of the less differentiated and more malignant osteogenic tumors the diagnosis can be made with certainty only by an exploration.

End-Results.

The end-results of benign giant cell tumors can be arranged in the following table in the same manner as the cases of osteogenic sarcoma, and the results are notably different.

BENIGN GIANT CELL SARCOMA.

A.	Total cases entered hospitals	14
B.	Re-entries	2
C.	Recurrence from previous operation (not eliminated)	0
D.	Cases without pathological report or evidence to support diagnosis	0
E.	Untraced	0
F.	Inconclusive (arbitrary 3 year limit not attained)	2
G.	Remainder, traced	10
H.	Radical operations { Amputations 3 / Resections 2 }	5
I.	Palliative operations (explorations only)	5
J.	No operation	0
K.	Operative deaths	1
L.	Operative mortality	10%
M.	Operability percentage—all cases	100%
N.	Operability percentage—radical operations	50%
O.	Number of cases alive and well (3 years)	8
P.	Number of cases died without recurrence (3 years+)	0
Q.	Total 3 year "cures" by radical operation	5
R.	Total 3 year "cures" all operations	8
S.	Percentage of "cures" by radical operation	100%
T.	Percentage of "cures" by all operations	80%

With the exception of the one patient that died of pneumonia after operation, all of the cases are living, and in only one case is there at present evidence of disease. The length of time following operation in two cases is only six months, and these two cases, therefore, have to be rejected. Of the remaining nine cases which survived operation, eight are free from disease at periods of time from four to ten years after operation. It would seem that no further evidence was needed to support the claim that the benign giant cell tumor is a local, non-metastasizing tumor, and that its removal or destruction is sufficient to produce a cure.

One case, number six, a benign giant cell tumor of the spine, received treatment with the Coley toxins directly into the tumor mass. One other case received treatment by radium after a partial excision. This is a recent case, however, and the x-ray still shows evidence of disease, although it is not extending. In none of the cases of this series could data in regard to x-ray treatment be obtained, but it is safe to say that no systematic series of x-ray treatments was given in any case.

ANGIO-SARCOMA.

There was one case in this series of angio-sarcoma of the ilium. These tumors are distinguished by Ewing as a special group of tumors of bony origin. The case was as follows:

CASE 17. A woman of sixty years had had pain in the left hip for seven months. A local examination showed a mass in the region of the left ilium. The x-ray showed a destructive process involving the ilium in the region of the left sacro-iliac joint. An exploratory operation was performed, and tissue removed for examination, which showed a tissue made up of new formed blood-vessels and containing trabeculae of bone. It could not be stated whether or not this bone was of new formation, and it is not at all impossible that it was the older trabeculae of the ilium which had resisted absorption longer than the rest of the tissue. No further treatment was given and the patient died in about six months.

MYELOMA.

Nine cases of myeloma were recorded in the hospital records during the ten-year period. Six of these cases, however, were cases of multi-

ple myeloma with characteristic symptoms, and no operative measures were undertaken, so that the positive microscopic proof of the disease was not available. Three cases came into the surgical wards, as follows:

Case 11. A man of fifty-five years, who for two years had had a gradually increasing tumor of the right ilium. The x-ray showed a definite pathological process involving that bone, the nature of which could not be determined. An exploratory operation was performed and tissue was removed for examination. The patient, however, was in very poor condition and died of hemorrhage two days later. There was no autopsy. The examination of the tissue showed a typical plasma cell myeloma. No other focus of disease could be discovered on clinical examination.

Case 20. A child of fifteen years. The child came to the hospital for an axillary abscess of two weeks' duration. X-ray examination showed an area in the upper two thirds of the humerus, with increased density and with scattered areas of diminished density. The case was regarded as one of osteomyelitis. Incision was made; no pus was found. The tissue removed suggested a myeloma. X-rays of the skull, spine, and of the long bones showed no other foci of disease. Bence-Jones bodies were absent. The second operation was performed and the diseased area was incised and curetted. The wound healed and the child was well four months later. The tissue removed showed the characteristic picture of a plasma cell myeloma.

Case 52. A man of forty-eight years applied at the Eye and Ear Infirmary for treatment of exophthalmos. A tumor of the outer wall of the orbit was removed. Examination of the tissue showed a typical plasma cell myeloma, but no other evidence of disease was found by x-ray, and there were no Bence-Jones bodies. Following this operation there was some thickening of the tissues in the region of the orbit, and radium treatment was employed by deep filtration, for six months. At that time a second operation was performed, the eye was enucleated and the tissues of the orbit were widely excised. Six months later there was no evidence of disease in the orbit, but another tumor had developed in the upper jaw. This tumor was excised and the cavity packed with radium. Examination of the tissue showed the same plasma cell myeloma that had been found in the orbit. Nine months later a tumor developed in the lower jaw, which was curetted. It was necessary to repeat the curetting twice in the next four months. It is now two years and a half since the last operation and the patient remains well.

These three cases of myeloma are recorded because of their peculiar character. In only one of the three was there evidence of a multiple lesion and that in only two bones. The pathological examination of

the tissue in these cases was similar in every way to the cases of multiple plasma cell myeloma which have been described in the literature. The x-rays were not distinctive and showed only a destructive process which might be mistaken for osteomyelitis or metastatic malignant disease. In two cases, operative removal of the tissue was apparently successful in relieving the patient, although the time elapsed in these two cases—six months and two and a half years—is too short to be conclusive. Neither case received Coley treatment, but radium was used in one case, although the benefit from radium treatment was not conspicuous.

SUMMARY.

1. One hundred and forty-eight cases of supposedly bone sarcoma reviewed for a ten-year period yielded for study:

Osteogenetic Sarcoma	27 cases
Benign Giant Cell Tumor	12 cases
Angio-Sarcoma	1 case
Myeloma	3 cases

2. The classification of Ewing has been adopted and of the tumors of the osteogenic group three types are distinguished, of which, however, only two are available in this series:

Sclerosing type	1 case
Telangiectatic	0 case
Fibro-cellular	26 cases

3. *Etiology:* The history of trauma shortly preceding symptoms is more often obtained in cases of osteogenic sarcoma than in other classes of malignant disease (10 out of 27 cases).

4. *Symptoms:* Osteogenic sarcomata are more common in young adults, but occur at all ages. They affect more often the epiphyseal ends of the long bones, especially femur and tibia, but are found occasionally in other situations. The chief symptoms are pain and tumor. Spontaneous fracture may occur but is unusual.

5. *Diagnosis:* Errors in diagnosis are common and result from confusion of bone sarcoma with other diseases, as:

Osteomyelitis, syphilis and tuberculosis (11 cases).
Benign tumors and diseases of bone as bone cyst and osteitis fibrosa (15 cases); Paget's disease (1 case); enchondroma and osteoma (10 cases).
Sarcoma of soft parts invading bone (28 cases).
Metastatic tumors as carcinoma, hypernephroma, lymphoma, melano-sarcoma, angio-endothelioma, myo-sarcoma, etc. (20 cases).
Neuro-blastoma (9 cases).
Chordoma (1 case).

We have examples of all these lesions being confused with bone sarcoma.

6. *X-rays:* The typical x-ray picture of the common form of periosteal osteogenic sarcoma is well recognized. Fourteen of this series of 28 cases were of this variety. In two cases a process of bone destruction with but little new bone formation was shown in the x-ray,—easily mistaken for metastatic cancer or osteomyelitis. In five cases the tumor was apparently central in origin, and no obvious new growth of bone beyond the cortex could be made out. The resemblance to a giant cell tumor in these cases is very marked.

7. *Pathology:* The attempt to distinguish osteogenic sarcoma by the intercellular substance produced by the tumor cells, or to make a hard and fast distinction between those of periosteal or medullary origin, appears to us, at present, to lead to confusion. We believe that the microscopic characteristics of the fundamental tissue of origin,—the spindle cell fibroblasts which are the progenitors of the bone forming tissue,—are the criteria on which the classification should be based. The degree of differentiation which this tissue undergoes into cartilage, bone, etc., is of less significance than the departure from normal of the cells.

8. *Treatment and Results:* Of 40 traced cases of osteogenic sarcoma, 23 had radical operative treatment, two had exploration only, and 15 were not operated upon. This gives an operability of 66 per cent. There was one operative death. There were three three-year cures, or 13 per cent. of radical operations. Early exploration, with permission for immediate amputation, is safer treatment in a doubtful case than delay. No material benefit was obtained by Coley serum in the four cases in which it was employed. The average duration of life of the cases dying of recurrence was 11.5 months.

Benign Giant Cell Tumor—12 Cases.

9. *Etiology:* Trauma appeared as a causative agent in only three cases.

10. *Symptoms:* These tumors occur commonly in young adults, but are encountered at all ages. Swelling and pain are the characteristic symptoms. Spontaneous fracture occurred in only one case.

11. *X-rays:* The x-ray picture of a benign giant cell tumor is fairly distinctive. The tumors are of central origin, commonly near the epiphyseal ends of the long bones, but the spine, pelvis, jaw, etc., may be affected. The x-ray shows bone absorption in irregular spaces bounded by bony trabeculae. The cortex is thin and expanded. The tumor often crosses the epiphyseal line but in none of our cases perforated the joint cartilage.

12. *Diagnosis:* Bone cysts, osteitis fibrosa, and osteomyelitis must be excluded as well as metastatic tumors and sarcoma of the osteogenetic type.

13. *Pathology:* Benign giant cell tumors are composed of fairly typical fibroblasts and large numbers of endothelial foreign-body giant cells which dominate the microscopic picture. These giant cells are not significant as far as the tumor growth is concerned, and the cells of the fibroblastic tissue are regular in size, shape, and outline and show little evidence of malignancy. Osteoid tissue and cartilage may be observed but can frequently be explained by the presence of an epiphyseal line or a spontaneous fracture. New bone production is not characteristic of the tumors. We have no instance of metastasis.

14. *Treatment and Results:* Of the 12 traced cases of benign giant cell tumor, two have to be discarded as only six months have elapsed since operation. Of the remaining 10 cases, three had amputation performed, two had resection, while the other five cases had only incomplete removal of the tumor by incision and curettage. Of these cases, one died of pneumonia immediately after operation, and one is living but with evidence of tumor still present six months after operation. The remaining eight cases have passed the three year limit without evidence of disease.

15. *Recurrence:* No evidence of metastasis of giant cell tumor is found in this series, and where recurrence has been observed it is local and apparently due to incomplete removal of the tumor.

Angio-Sarcoma.

16. One case of this group occurred in the series,—a man of 60, with a tumor, apparently primary, in the ilium. No treatment other than exploratory operation was attempted, and the patient died within six months.

Myeloma.

17. Nine cases appeared in the records, but pathological proof of the diagnosis was obtained in only three. All three cases showed the microscopic picture of plasma cell myeloma, but in none did it appear to be systemic, and no Bence-Jones bodies were ever demonstrated. Two were instances of single foci of disease,—one of the ilium, the other of the humerus. The first case died of hemorrhage after an exploratory operation. The second case is alive and well three months after incision and curettage. The third case is of interest in that the

tumor appeared first in the orbit; two excisions were performed, with enucleation of the eye. Two years later, another tumor developed in the lower jaw. This was excised, recurred, and again excised, and the cavity treated by radium insertion. The case is now two years under observation without recurrence.

ABSTRACT OF OSTEOGENIC SARCOMA CASES.

CASE 2. *Hospital*—Massachusetts General, No. 205653. *Diagnosis*—Osteogenic sarcoma—tibia. *Sex*—Male. *Age*—41 years. *Duration*—Six months; swelling of the knee. *Examination*—Enlargement of head of tibia. *X-ray*—"Extensive process upper end of tibia, probably giant-cell sarcoma." *Operation*—Amputation, mid-thigh. *Gross Examination*—Whitish growth, necrotic centre, filling upper part of shaft of tibia. *Microscopic Examination*—Ostogenic sarcoma. Fibro-cellular tumor; much necrosis, pleo-morphic cells and osteoid tissue (central type. *Result*—Died, three and a half years.

CASE 5. *Hospital*—Massachusetts General; No. 22879. *Diagnosis*—Osteogenic sarcoma—femur. *Sex*—Male. *Age*—58 years. *Duration*—One year; pain. *Examination*—Thickening about lower end of femur. *X-ray*—Cavity in external condyle, with increased growth of bone under periosteum. *Operation*—Exploratory operation for osteomyelitis. Three months later, amputation of mid-thigh. *Gross Examination*—New-growth, involving condyle and extending outward under periosteum. *Microscopic Examination*—Osteogenic sarcoma. Dense, fibroblastic tissue; irregular pleomorphic cells with osteoid tissue (central type). *Result*—Two years; living, with recurrence in lung and abdomen.

CASE 7. *Hospital*—Massachusetts General; No. 220560. *Diagnosis*—Osteogenic sarcoma—femur. *Sex*—Male. *Age*—47 years. *Duration*—Five months; pain and limitation of motion. *Examination*—Mass in region of right hip. *X-ray*—Area of diminished density, greater trochanter. *Operation*—Exploration. Amputation refused. *Gross Examination*—Fragments of tissue with spongy bone. *Microscopic Examination*—Osteogenic sarcoma. Fibroblastic cellular tissue; cells pleomorphic; osteoid tissue. *Results*—Returned to hospital one month later; disease then considered inoperable.

CASE 8. *Hospital*—Massachusetts General; No. 224493. *Diagnosis* Osteogenic sarcoma—tibia. *Sex*—Male. *Age*—17 years. *Duration* Three months; pain and swelling. *Examination*—Tumor, upper third of tibia. *X-ray* Destructive process, upper end of tibia; worm-eaten appearance. *Operation*—Exploratory incision, followed by amputation of thigh. *Gross Examination*—Fibrous tumor, soft, reddish-gray, involving medulla and cortex. *Microscopic Examina-*

tion—Osteogenic sarcoma. Highly cellular stroma; pleomorphic cells with many mitoses; differentiated to cartilage and bone. *Result*—Died in one year; lung recurrence.

FIG. 1.

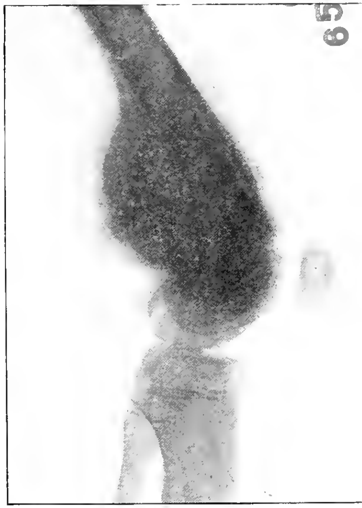

FIG. 2.

FIG. 1.—Case 9. Osteogenetic sarcoma of the lower end of the femur in a boy of ten. The tumor has dissected up the periosteum and infiltrated the medulla. Amputation. Death one year later of lung metastases. (See Fig. 2.)

FIG. 2.—Case 9. Osteogenetic sarcoma of periosteal origin of the lower end of the femur. (See Fig. 1.) The radiating lines of new formed bone in the periosteal tumor and the dissecting up of the periosteum are characteristic of this form of sarcoma.

CASE 9. *Hospital*—Massachusetts General; No. 237896. *Diagnosis*—Osteogenic sarcoma—femur. *Sex*—Male. *Age*—10 years. *Duration*—Five months; tumor. *Examination*—Fluctuating tumor, size of orange, lower end of femur; skin red; veins dilated. *X-ray*—Periosteal type of tumor with radiating lines of new formed bone, involving also medullary cavity. *Operation*—Amputation, mid-thigh. *Gross Examination*—Tumor lower end of femur, dissecting up periosteum; medullary cavity infiltrated. *Microscopic Examination*—Os-

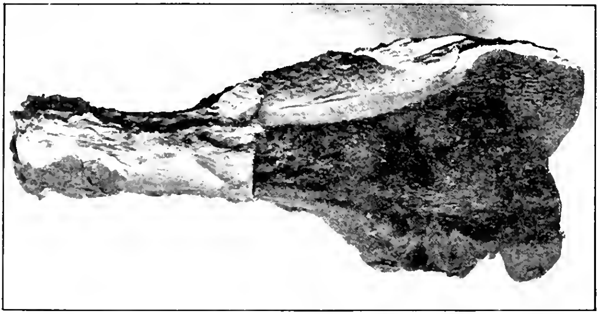

FIG. 3.—Case 26. Osteogenetic sarcoma of the lower end of the femur in a man 31 years of age, of three months' duration. The tumor originated under the periosteum but invades the medulla. Amputation. No evidence of disease 15 months later. (See Fig. 4.)

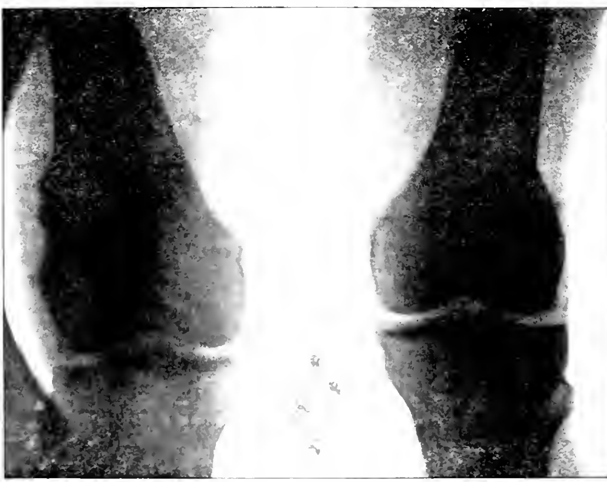

FIG. 4. Case 26. Osteogenetic sarcoma of the lower end of the femur of periosteal type. (See Fig. 3.)

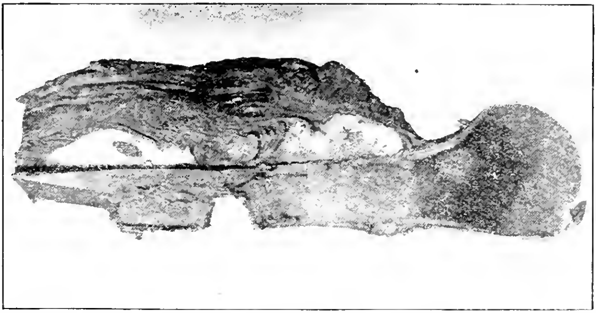

FIG. 5.—Case 23. Photograph of specimen. (See Fig. 6.) There is a large tumor under the periosteum, invading the soft parts and extending into the medulla. An isolated tumor nodule can be seen near the head of the bone.

FIG. 6.—Case 23. Osteogenetic sarcoma of humerus, destructive type, of six weeks' duration in a man of 32 years. The humerus has a worm-eaten appearance and there is very little new bone formation. Amputation. Death from recurrence in three months. (See Fig. 5.)

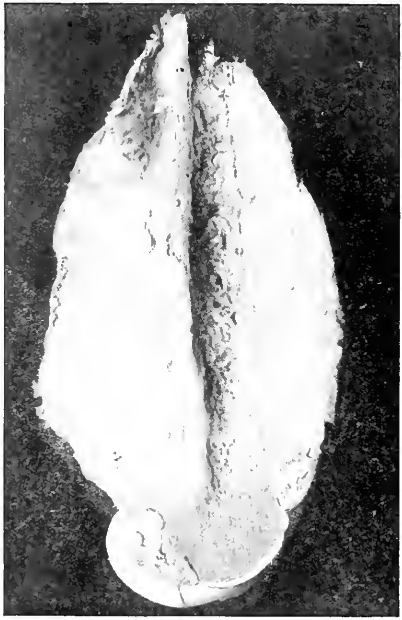

FIG. 7.—Case 12. Osteogenetic sarcoma of the lower end of the femur of one year's duration in a woman 34 years old. Periosteal type with much new bone formation (sclerosed type of Ewing) and little involvement of the marrow cavity. Amputation. Living without evidence of disease three years later.

teogenic sarcoma. Pleomorphic fibro-cellular tumor, new bone and cartilage production; many mitoses. *Result*—Death in one year; lung metastasis.

CASE 12. *Hospital*—Massachusetts General; No. 222422. *Diagnosis* Osteogenic sarcoma, sclerosing type—femur. *Sex*—Female. *Age*—34 years. *Duration*—One year; swelling and pain. Trauma six years before. *Examination*—Hard fusiform tumor, lower end of femur. *X-ray*—Tumor arising from periosteum, lower end of femur. Dense shadow with radiating lines of periosteal tumor. *Operation*—Exploration and immediate mid-thigh amputation. *Gross Examination*—Hard, bony tumor of cortex of shaft of femur with areas of soft

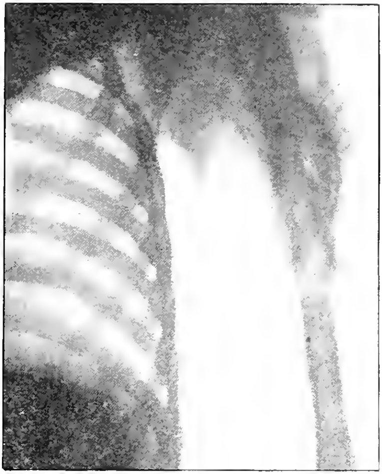

FIG. 8.—Case 55. Osteogenetic sarcoma of the periosteal type in a girl of 12 years. There is much bone destruction with a pathological fracture, and some bone formation, but the characteristic radiating lines of periosteal sarcoma are not seen. Amputation two weeks after exploratory incision. No recurrence ten months later. (See Fig. 9.)

tissue scattered through the bone. Medullary cavity not obliterated. *Microscopic Examination*—Osteogenic sarcoma. Cellular fibroblastic tissue with many areas of osteoid tissue, cartilage, and bone. Relatively few mitotic figures. *Result*—Well, three years.

CASE 22. *Hospital*—Massachusetts General; No 211086. *Diagnosis*—Osteogenic sarcoma—fibula. *Sex*—Male. *Age*—28 years. *Duration*—Eight months; pain and tumor. Trauma one month before onset. Two previous operations for supposed osteomyelitis, one month and four months after onset of symptoms. *Examination*—Fusiform swelling, lower end of fibula; foot swollen. *X-ray*—Central tumor lower end of fibula, destroying bone and extending through cortex to soft parts in one area (suggests benign giant cell tumor). *Operation*—Resection lower end of fibula. *Gross Examination*—Tumor occupies lower end of fibula, destroying shaft and infiltrating cortex and medulla; apparently encapsulated. *Microscopic Examination*—Osteogenic sarcoma. Chiefly small, round cellular fibroblastic tissue with new bone formation. *Result*—Died in one year; lung metastasis.

FIG. 9.—Case 55. Photograph of specimen. (See Fig. 8.) The pathological fracture, partially healed, is seen.

CASE 23. *Hospital*—Massachusetts General; No. 215298. *Diagnosis*—Osteogenic sarcoma—humerus. *Sex*—Male. *Age*—32 years. *Duration*—Five weeks; pain and rapidly growing tumor. Injury to arm immediately before onset. *Examination*—Large tumor mass upper end of shaft of humerus; red and fluctuating. *X-ray*—Worm eaten appearance of diffuse bone absorption, upper half of humerus; slight periosteal proliferation; suggests osteomyelitis or central sarcoma. *Operation*—Exploratory incision and immediate amputation at shoulder-joint. *Gross Examination*—Large tumor infiltrating upper end of humerus and adjacent soft parts. Considerable bone destruction and medullary cavity infiltrated. One nodule in head of humerus. *Microscopic Examination*—Osteogenic sarcoma. Large pleomorphic, fibroblastic type of cells; many mitoses; osteoid tissue, cartilage, and new bone. *Result*—Died. Symptoms not stated; few months after leaving hospital.

CASE 25. *Hospital*—Massachusetts General; No. 180922. *Diagnosis*—Osteogenic sarcoma—tibia. *Sex*—Female. *Age*—15 years. *Duration*—Three months. Pain; later swelling, immediately following trauma. *Examination*—Diffuse fusiform swelling upper end of tibia; slightly tender. *X-ray*—"Typical periosteal sarcoma." Not available for reëxamination. *Operation*—Amputation of mid-thigh. *Gross Examination*—Dense, whitish tumor, grating under knife, originating in head of tibia and extending outward from cortex. *Microscopic Examination*—Osteogenic sarcoma. Large fibroblastic type of cells, round and spindle in shape. Many mitoses, differentiating into osteoid tissue, cartilage, and bone. *Result*—Died six months later; local and lung recurrence.

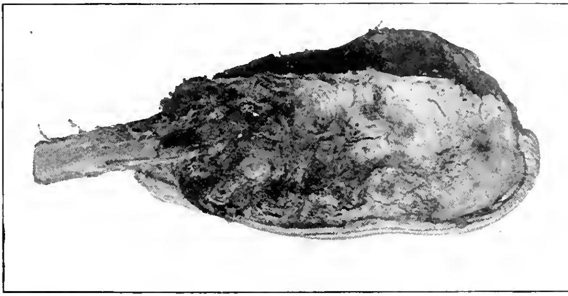

FIG. 10.—Case 22. Osteogenetic sarcoma of central origin in the lower end of the fibula in a man 28 years old. Nine months' duration. Two previous operations for "osteomyelitis." Resection. Death one year later from lung metastasis. (See Fig. 11.)

CASE 26. *Hospital*—Massachusetts General; No. 234464. *Diagnosis*—osteogenic sarcoma—femur. *Sex*—Male. *Age*—31 years. *Duration*—Three months; pain and tumor. *Examination*—Fusiform tumor, lower end of left femur. *X-ray*—Extensive proliferative and destructive process; cortex destroyed, radiating lines of new bone extending outward. *Operation*—Amputation of femur. *Gross Examination*—Tumor originating under periosteum, lower end of femur, extending outward; medullary cavity infiltrated. *Microscopic Examination*—Osteogenic sarcoma. Large spindle shaped cells; differentiated to osteoid tissue, cartilage, and bone; few mitoses. *Result*—Well, fifteen months.

CASE 27. *Hospital*—Massachusetts General; No. 195458. *Diagnosis*—Osteogenic sarcoma—femur. *Sex*—Male. *Age*—20 years. *Duration*—Seven months; pain and tenderness *Examination*—Fusiform tumor of lower half of femur. *X-ray*—No data preserved. *Operation*—Amputation of thigh. *Gross Examination*—Spindle shaped growth involving lower end of femur, 8 cm. in diameter; cystic areas and bone. *Microscopic Examination*—Osteogenic sarcoma. Cellular, pleomorphic, fibroblast tissue; "tumor" giant cells; osteoid tissue and bone formation. *Result*—Died, with symptoms of lung recurrence, eighteen months.

CASE 28. *Hospital*—Massachusetts General; No. 195542. *Diagnosis*—Osteogenic sarcoma—tibia. *Sex*—Female. *Age*—24 years. *Duration*—Six months; tumor below knee. *Examination*—Hard, inelastic tumor, size of half an orange, over head of tibia; tender and veins dilated. *X-ray*—"Periosteal sarcoma." Not available for re-examination. *Operation*—Amputation mid-thigh. *Gross Examination*—Hard tumor, head of tibia, infiltrating bone. *Microscopic Examina-*

FIG. 11.—Case 22. Central osteogenetic sarcoma of the lower end of the fibula, in a man of 28 years. (See Fig. 10.) The picture closely resembles that of central giant cell tumor.

tion—Osteogenic sarcoma. Fibroblastic cellular tumor, differentiated to myxoma, osteoid tissue, and bone. Few mitoses. *Result*—Died five years and four months later, of pneumonia, during influenza epidemic, after brief illness. No evidence of recurrence.

CASE 30. *Hospital*—Massachusetts General; No. 185952. *Diagnosis*—Osteogenic sarcoma—tibia. *Sex*—Male. *Age*—16 years. *Duration*—Unknown. *Examination*—Tumor size of orange in popliteal space; ulcerated. *X-ray*—Showed periosteal involvement of upper end of tibia. *Operation*—Amputation mid-thigh. *Gross Examination*—Tumor of upper part of leg, originating in tibia, infiltrating muscles. *Microscopic Examination*—Osteogenic sarcoma. Cellular, fibroblastic tissue; large round and spindle cells; differentiated to osteoid and myxomatous tissue and cartilage. Foreign-body giant cells. *Result*—Died one year later; lung metastases.

CASE 31. *Hospital*—Massachusetts General; No. 207366. *Diagnosis*—Osteogenic sarcoma—femur. *Sex*—Male. *Age*—38 years. *Duration*—Fifteen months, pain; tumor two months. *Examination*—Thick-

FIG. 12.—Case 35. Giant cell tumor of two years' duration in a negro, 40 years of age. There is a very thin shell of bone left around the tumor. The joint cartilage is intact. Resection. No evidence of recurrence five and one-half years later. (See Fig. 13.)

FIG. 13.—Case 35. Photograph of specimen. (See Fig. 12.) The articular surface can be seen to the left, and a short section of the normal ulna to the right. The tumor itself is hæmorrhagic and friable.

ening about great trochanter; not tender; veins dilated. *X-ray*—Typical periosteal tumor infiltrating head and neck of femur, and half way down shaft. *Operation*—Exploratory incision and removal of specimen; considered inoperable. *Gross Examination*—Fragments of

tissue. *Microscopic Examination*—Osteogenic sarcoma. Pleomorphic type: fibroblastic tissue; differentiated to cartilage and bone. *Result*—Died three months later.

CASE 34. *Hospital*—Massachusetts General; No. 185610. *Diagnosis*—Osteogenic sarcoma—tibia. *Sex*—Male. *Age*—26 years. *Duration*—Eighteen months, tumor; bloody sputum lately. *Examination*—Large tumor upper end of tibia; ulcerated. Previous exploratory operation. *X-ray*—"Sarcoma of tibia." Not available for reëxamination; metastases in lung. *Operation*—Amputation of thigh with dissection of groin. *Gross Examination*—Tumor upper end of tibia, reddish color. Joint not involved. *Microscopic Examination*—Osteogenic sarcoma. Pleomorphic, fibroblastic tumor; large, irregular cells; many mitoses; differentiated to cartilage, myxomatous tissue, and bone; much necrosis. *Treatment*—Coley serum. *Result*—Died seven months later; local and lung recurrence.

CASE 36. *Hospital*—Massachusetts General; No. 203722. *Diagnosis*—Osteogenic sarcoma—femur. *Sex*—Male. *Age*—20 years. *Duration*—Five months, following trauma; pain; later tumor. *Examination*—Tumor lower end of femur, soft, red, and tender. *X-ray:*—"Probable periosteal sarcoma;" not available for reëxamination. *Operation*—Amputation mid-thigh. *Gross Examination*—Tumor involving condyle of femur. *Microscopic Examination*—Osteogenic sarcoma. Fibrocellular tissue; oedema; differentiated to cartilage, myxomatous tissue, and bone; few tumor giant cells. *Results*—Lung metastases fourteen months later.

CASE 39. *Hospital*—Massachusetts General; No. 201213. *Diagnosis*—Osteogenic sarcoma—ribs. *Sex*—Female. *Age*—17 years. *Duration*—Four months, following trauma; tumor. *Examination*—Hard tumor 4 cm. in chest wall. *X-ray*—Not available for study. *Operation*—Resection fourth to ninth ribs with tumor. *Gross Examination*—Portion of ribs with large tumor mass arising from one rib. *Microscopic Examination*—Osteogenic sarcoma. Fibroblastic tissue with many blood spaces, cartilage, and bone. *Result*—Died in six months; lung involvement.

CASE 41. *Hospital*—Massachusetts General; No. 200860. *Diagnosis* Osteogenic sarcoma—tibia. *Sex*—Female. *Age*—16 years. *Duration*—Three months, pain in knee. *Examination*—Tumor of upper end of tibia, size of an orange. *X-ray*—Not available for study. *Operation*—Amputation mid-thigh three weeks after exploratory incision. *Gross Examination*—Opaque tumor arising in periosteum and infiltrating head of tibia. *Microscopic Examination*—Osteogenic sarcoma. Very cellular fibroblastic type, large and rounded cells; many mitoses; differentiated to osteoid tissue and bone; occasionally tumor giant cell. *Result*—Died one year later after second operation for local recurrence.

CASE 44. *Hospital*—Massachusetts General; No. 223558. *Diagnosis*—Osteogenic sarcoma—lower jaw. *Sex*—Male. *Age*—65 years. *Duration*—Two and a half months; pain; later tumor. *Examination*—

FIG. 14.—Case 3. Giant cell tumor of the upper end of the humerus of two years' duration in a girl of 13 years. The tumor extends through the epiphyseal cartilage. Curetted. No evidence of recurrence fifteen months later.

Tumor filling ramus of lower jaw; ulcerated. *X-ray*—Not available for reëxamination. *Operation*—Resection one-half of lower jaw, following incision and curettage in another hospital. *Gross Examination*—Tumor mass involving jaw and infiltrating bone, 4 x 6 cm. *Microscopic Examination*—Osteogenic sarcoma. Fibrous type; fibroblastic tissue differentiated to osteoid tissue and bone. *Result*—Well, three years.

CASE 45. *Hospital*—Massachusetts General; No. 175122. *Diagnosis*—Osteogenic sarcoma—tibia. *Sex*—Male. *Age*—17 years. *Duration*—Three months; pain; later tumor. *Examination*—Fusiform tumor upper end of tibia. *X-ray*—No record. *Operation*—Exploratory incision and immediate amputation of mid-thigh. *Gross Examination*—Tumor involving head of tibia, extending to soft parts; cortex and medulla infiltrated. *Microscopic Examination*—Osteogenic sarcoma. Fibroblastic tissue; large and rounded cells; differentiated to osteoid tissue, cartilage, and bone. *Result*—Metastasis in spine, ten months later.

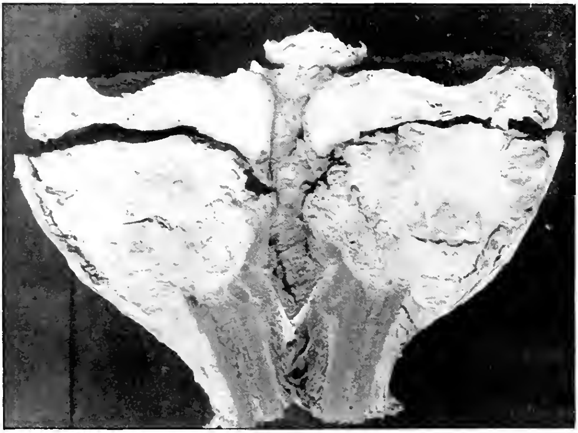

FIG. 15.—Case 21. Large giant cell tumor, upper end of tibia, in a woman 44 years old. The bone is reduced to a thin shell and there is a pathological fracture, but the joint is not invaded. Amputation. No evidence of recurrence three years later.

CASE 47. *Hospital*—Massachusetts General; No. 204119. *Diagnosis*—Osteogenic sarcoma—tibia. *Sex*—Male. *Age*—53 years. *Duration*—Five months; tumor. *Examination*—Tumor, posterior aspect of tibia, hard, not tender; size of an orange. *X-ray*—Bony tumor involving posterior aspect of tibia, suggests periosteal sarcoma. Not available for reëxamination. *Operation*—Exploratory incision with removal of specimen. Mid-thigh amputation one week later. *Gross Examination*—Grayish tumor, soft consistency, involving upper end of tibia. *Microscopic Examination*—Osteogenic sarcoma. Fibroblastic tissue; differentiated to cartilage and bone. Specimen also shows areas of fibrous stroma with hæmorrhage, and foreign-body giant cells (benign giant cell tumor). *Result*—Died in one year; lung recurrence.

CASE 48. *Hospital*—Massachusetts General; No. 186737. *Diagnosis*—Osteogenic sarcoma—spine. *Sex*—Male. *Age*—42 years. *Duration*—Six months; pain; tumor lately. *Examination*—Large tumor right iliac fossa, extending over sacrum and lower lumbar vertebrae. *X-ray*—Indefinite mass right iliac fossa; not available for reëxamination. *Operation*—Exploratory incision; large tumor mass connected with transverse processes of lumbar vertebrae, and extending into iliac fossa. *Gross Examination*—Gray, firm cartilaginous fragments of tumor tissue. *Microscopic Examination*—Osteogenic

sarcoma Chiefly cartilage and new bone, and areas of fibroblastic cellular tissue. *Result*—Died one year later; general sarcomatosis.

CASE 49. *Hospital*—Massachusetts General; No. 186737. *Diagnosis*—Osteogenic sarcoma—ischium. *Sex*—Male. *Age*—42 years. *Duration*—Six months; pain and tumor. *Examination*—Smooth, rounded tumor, pubis to ischium. *X-ray*—Loss of bone substance right side of pelvis (not available for study). *Operation*—Exploratory incision; firm tumor containing cystic areas. *Gross Examination*—Fragments of firm grayish-white tumor tissue. *Microscopic Examination*—Osteogenic sarcoma. Large fibroblastic cells with vesicular nuclei; pleomorphic; many mitoses; few tumor giant cells (differentiation to osteoid tissue and bone). *Treatment*—Coley toxines administered. *Result*—Died four months later.

CASE 54. *Hospital*—Collis P. Huntington Memorial—18-985. *Diagnosis*—Osteogenic sarcoma—tibia. *Sex*—Male. *Age*—21 years. *Duration*—Nine months; pain; tumor later. Three exploratory operations in six months for supposed osteomyelitis, followed by amputation at mid-thigh three months before entrance to Huntington Hospital. *Examination*—Mid-thigh stump, bone protruding. No evidence of local recurrence. *X-ray*—Of chest shows lung recurrence. *Gross Pathology*—No report. *Microscopic Examination*—Osteogenic sarcoma. From specimen removed at amputation shows pleomorphic, fibroblastic, cellular tissue; alveolar arrangement; large vesicular nuclei; mitoses abundant; tumor giant cells; small areas of hæmorrhage; differentiated to osteoid tissue. *Result*—Died one month later.

CASE 55. *Hospital*—Collis P. Huntington Memorial—20-322. *Diagnosis*—Osteogenic sarcoma—humerus. *Sex*—Female. *Age*—12 years. *Duration*—Doubtful; pathologic fracture ten days before entrance. *Examination*—Large, lobulated tumor upper half of humerus; red, tender, and fluctuant. *X-ray*—Much bone destruction and some new bone formation upper half of humerus, with pathological fracture; suggests osteomyelitis. *Operation*—Exploratory incision; specimen showed sarcoma; two weeks later, amputation at shoulder-joint. *Gross Examination*—Large tumor occupying upper end of humerus and extending into soft parts; soft and gray, with areas of necrosis with cortex destroyed and fracture of upper third. *Microscopic Examination*—Osteogenic sarcoma. Large-celled fibroblastic tissue; alveolar arrangement; infiltrating soft parts and bone; differentiated to osteoid tissue, cartilage, and bone. Infiltrating and destructive type of tumor. *Result*—Well, one year; no evidence of local or internal recurrence.

CASE 56. *Hospital*—Collis P. Huntington Memorial—20-813. *Diagnosis*—Osteogenic sarcoma—upper jaw. *Sex*—Male. *Age*—12 years. *Duration*—Eleven months, tumor; later, exophthalmos; loss of vision. *Examination*—Enormous tumor of upper jaw, displacing eye and

palate and extending into zygomatic fossa. *X-ray*—Large tumor mass in region of antrum. *Operation*—Resection of upper jaw and tumor. *Gross Examination*—Firm, grayish tumor tissue, showing areas of degeneration and oedema, apparently springing from region of ethmoid cells and involving and destroying upper jaw. *Microscopic Examination*—Osteogenic sarcoma. Fibroblastic cellular tissue, relatively uniform in character; many lymph spaces and blood channels; differentiated to myxomatous and osteoid tissue. *Result*—Died twenty-four hours following operation, shock and hemorrhage.

Case 57. *Hospital*—Collis P. Huntington Memorial—16-151; Massachusetts General Hospital—No. 207195. *Diagnosis*—Osteogenic sarcoma—femur. *Sex*—Male. *Age*—14 years. *Duration*—Two months; pain. *Examination*—Tumor lower end of femur; enlarged glands in groin and abdomen. *X-ray*—Periosteal new growth lower end of femur; new bone formation and medulla invaded. *Operation*—Massachusetts General Hospital. Amputation of thigh. *Gross Examination*—Tumor originating under periosteum, lower end of femur; infiltrating medullary cavity. *Microscopic Examination*—Osteogenic sarcoma. Pleomorphic fibroblastic cellular tissue; alveolar arrangement; differentiation to osteoid tissue, cartilage, and bone. Foreign-body giant cells. *Result*—Died two and a half months later, with extension to abdominal cavity.

ABSTRACT OF BENIGN GIANT-CELL TUMOR CASES.

Case 1. *Hospital*—Massachusetts General; No. 206129. *Diagnosis* Benign giant-cell tumor—phalanx. *Sex*—Female. *Age*— 58 years. *Duration*—One year; tumor and pain. Incision and curetting six months before entrance. *X-ray*—Central expanding tumor, thin cortex; bone destruction. *Operation*—Amputation of finger. *Gross Examination*—Soft, red tumor tissue within thin bone shell of cortex of phalanx. *Microscopic Examination*—Benign giant-cell tumor. Many large, multinucleated giant-cells, fibrocellular stroma; areas of hæmorrhage; no new bone production. *Result*—Well, five years.

Case 3. *Hospital*—Massachusetts General; No. 224111. *Diagnosis*—Benign giant-cell tumor—head of humerus. *Sex*—Female. *Age*—13 years. *Duration*—One year; tumor of shoulder; pain recently. *Examination*—Hard, smooth tumor, size of an egg, greater tuberosity. *X-ray*—Central tumor, crossing epiphyseal line, thin cortex; bone destruction. *Operation*—Incision and curettage. *Gross Examination*—Red, friable fragments of tumor tissue. *Microscopic Examination*—Benign giant-cell tumor. Numerous small giant-cells, fibrous type stroma; new bone and cartilage (attributed to line of epiphysis). *Result*—Well, fifteen months.

Case 4. *Hospital*—Massachusetts General; No. 238762. *Diagnosis*—Benign giant-cell tumor—great trochanter. *Sex*—Female. *Age*—

13 years. *Duration*—Eight months, pain and lameness. *Examination*—Thickening over trochanter; hip motion slightly restricted. *X-ray*—Central tumor, great trochanter, extending through epiphysis; thin cortex: bone destruction. *Operation*—Incision and curettage. *Gross Examination*—Red, friable fragments of tumor tissue. *Microscopic Examination*—Benign giant-cell tumor. Many large giant-cells, cellular type fibrous stroma; new bone and cartilage (attributed to line of epiphysis). *Result*—Well, six months.

CASE 6. *Hospital*—Massachusetts General; No. 183172. *Diagnosis*—Benign giant-cell tumor—spine. *Sex*—Male. *Age*—16 years. *Duration*—Trauma three months before symptoms; three months' pain and tenderness, and thickening over lumbar spine. *X-ray*—Small tumor arising from lateral surface spinous process third lumbar vertebra. *Operation*—Excision (partial). *Gross Examination*—Fragments of tissue. *Microscopic Examination*—Benign giant-cell tumor. Many small giant-cells, stroma fibrous type; no hæmorrhagic areas; no new bone. Local recurrence in wound immediate. Received Coley toxin treatment by injection direct into tumor, for seven months (sixty-two injections). Tumor sloughed out and wound healed. Two years later tumor appeared in scar; excised and found to be a cyst; inflammatory tissue; no tumor tissue found. *Result*—Well eight years after first operation.

CASE 18. *Hospital*—Massachusetts General; No. 208764. *Diagnosis*—Benign giant-cell tumor—lower jaw. *Sex*—Female. *Age*—8 years. *Duration*—Three months' tumor. *Examination*—Smooth, hard tumor right side of lower jaw. *X-ray*—Destroyed; not available. *Operation*—Incision and curettage. *Gross Examination*—Fragments of tissue from central tumor of lower jaw. *Microscopic Examination*—Benign giant-cell tumor. Many giant-cells, stroma very fibrous; areas of hæmorrhage; some bone trabeculae found; no evidence of new bone formation. *Result*—Well; no recurrence, four and a half years.

CASE 19. *Hospital*—Massachusetts General; No. 214282. *Diagnosis*—Benign giant-cell tumor—femur. *Sex*—Female. *Age*— 9 years. *Duration*—Two days. Spontaneous fracture of femur. *X-ray*—Central tumor of lower end of shaft of femur with bone destruction and fracture. *Operation.*—Incision, curettage, reduction of fracture. *Gross Examination*—Fragments of tissue. *Microscopic Examination*—Benign giant-cell tumor. Few giant-cells, cellular fibrous stroma; hæmorrhagic areas; no new bone formation. *Result*—Well four years later; good union.

CASE 21. *Hospital*—Massachusetts General; No. 210501. *Diagnosis*—Benign giant-cell tumor—tibia. *Sex*—Female. *Age*—44 years. *Duration*—Three and a half years. *Examination*—Tumor size of a grapefruit, head of tibia. *X-ray*—Central tumor expanding cortex; bone destruction; spontaneous fracture. *Operation*—Amputation of

thigh. *Gross Examination*—Central tumor of head of tibia, gray, firm; thin shell of cortex broken in places. *Microscopic Examination*—Benign giant-cell tumor. Many large giant-cells; fibrous stroma; no marked hæmorrhage; no new bone formation. *Result*—Well, four and a half years.

CASE 35. *Hospital*—Massachusetts General; No. 201079. *Diagnosis*—Benign giant-cell tumor—ulna. *Sex*—Male (colored). *Age*—40 years. *Duration*—Fifteen months. *Examination*—Tumor of elbow, rapid recent growth, size of fist, upper end of ulna; motion slightly restricted. *X-ray*—Central tumor, expanding upper end of ulna; thin cortical shell; no extension into joint. *Operation*—Resection of upper third of ulna. *Gross Examination*—Central friable tumor, many hæmorrhagic areas, distinct thin bone-shell; articular cartilage intact. *Microscopic Examination*—Benign giant-cell tumor. Large number of giant-cells; cellular stroma; much hæmorrhage; no new bone elements. *Result*—Well, six years.

CASE 37. *Hospital*—Massachusetts General; No. 175702. *Diagnosis*—Benign giant-cell tumor—tibia. *Sex*—Male. *Age*—27 years. *Duration*—One year pain; later swelling over head of tibia. *X-ray*—"Dense shadow, head of tibia." Not preserved for reëxamination. *Operation*—Incision and curettage of giant-cell tumor in March; repeated in April; amputation, mid-thigh, done in May. *Gross Examination*—No record. *Microscopic Examination*—Benign giant-cell tumor. Few giant-cells; cellular stroma of fibroblasts; several areas of hæmorrhage, some new bone formation attributed to healing of fracture. *Result*—Well, ten years.

CASE 38. *Hospital*—Massachusetts General; No. 178456. *Diagnosis*—Benign giant-cell tumor—fibula. *Sex*—Female. *Age*—33 years. Duration—One and a half years; trauma immediately before tumor; lameness. *X-ray*—No record. *Operation*—Resection, upper end of fibula. *Gross Examination*—Central lobulated new growth; thin, bony walls and cysts of thin, bloody fluid. *Microscopic Examination*—Benign giant-cell tumor. Many giant-cells; cellular stroma; hæmorrhagic areas; no bone formation. *Result*—Well, ten years.

CASE 51. *Hospital*—Collis P. Huntington Memorial—15-95. *Diagnosis*—Benign giant-cell tumor—upper jaw. *Sex*—Male. *Age*—28 months. *Duration*—Six months. *Examination*—Tumor of upper jaw filling antrum, displacing eye and depressing palate. *X-ray*—No record. *Operation*—resection; colonic ether anæthesia, transfusion. *Gross Examination*—Upper jaw containing soft red tumor tissue. *Microscopic Examination*—Benign giant cell tumor. Numerous giant-cells; rich fibrocellular stroma with considerable variation in size and shape of cells; small areas of hæmorrhage; no evidence of new bone. *Result*—Death in twenty-four hours; shock; lobar pneumonia. Autopsy No. 3492.

CASE 58. *Hospital*—Collis P. Huntington Memorial——20-1222. *Diagnosis*—Benign giant-cell tumor—radius. *Sex*—Female. *Age*—68 years. *Duration*—Three months; pain. *Examination*—Tumor lower end of radius. *X-ray*—Central tumor, destroying bone. *Operation*—Incision and curettage; immediate recurrence and rapid growth. Operation, four months later, incision, curettage, cavity packed with radium emanation in steel needles. Second radium treatment (external) two months later. *Gross Examination*—Fragments of red, friable tissue. *Microscopic Examination*—Benign giant-cell tumor. Many giant-cells; rich cellular stroma; much hæmorrhage; no bone formation. *Result*—Eleven months from first operation wound healed; no evidence of recurrence.

ABSTRACT OF ANGIO-ENDOTHELIOMA CASE.

CASE 17. *Hospital*—Massachusetts General; No. 194019. *Diagnosis*—Angiosarcoma—ilium. *Sex*—Female. *Age*—60 years *Duration*—Seven months; pain. *Examination*—Mass 3 x 8 cm. right iliac fossa, attached to ilium; not tender. *X-ray*—Shows pathological process, involving sacroiliac region. *Operation*—Exploratory incision; soft tumor with thin bony capsule; curettage. *Gross Examination*—Fragments of soft, reddish tissue. *Microscopic Examination*—Angiosarcoma. Tumor tissue composed largely of blood spaces in a stroma of irregular pleomorphic fibroblastic tissue; the blood spaces lined with large, irregular endothelial cells; areas of osteoid tissue, question whether newformed or not. *Result*—Died in six months.

ABSTRACT OF MYELOMA CASES.

CASE 11. Massachusetts General; No. 185159. Abstracted in text.

CASE 20. Massachusetts General. No. 137240. Abstracted in text.

CASE 52. Massachusetts General; No. 221685. Collis P. Huntington Memorial; No. 15-382. Abstracted in text.

DISCUSSION OF PAPER BY DRS. GREENOUGH, SIMMONS, AND HARMER.

DR. E. A. CODMAN, Boston: I thank you very much for the opportunity to discuss this paper. I have tried to study the subject of bone sarcoma for only a year, and I do not have any claim to be an authority on it. I have not cured cases, and have nothing to speak about in that way. I cannot even authoritatively discuss the paper, but I can tell you in a few words the reason that I think it is an important paper, and a little about the Registry of Bone Sarcoma.

The paper has taught me more on some points than I have been able to get out of the Registry. In the Registry we have endeavored to get in communication with as many surgeons in this country as possible, and ask them to send us a brief account with x-ray and pathological specimen, of any living cases of bone sarcoma that they have or suppose they have. We have laid an accent on "suppose they have," because, naturally, many men have made the same mistake that we did in the case related by Dr. Greenough, in suppos-

ing it was bone sarcoma when it was really cancer. I hope the members of this Association will help us in the same way, and register any cases that they have with us, that is, with Dr. Bloodgood, Dr. Ewing, and myself. We are endeavoring to register these cases so as to get the specimens and put them together in some place where they will be available for the study of anyone who is authorized or is interested to study them. We have collected a good many cases, but have not found as many cases of true sarcoma as have been reported in this paper. This series of Dr. Greenough and Dr. Simmons gives us hope in a case of true osteogenic sarcoma, that amputation may cure it. We have been able to find but few others in the whole country. There is one objection to accepting Dr. Greenough's and Dr. Simmons's cases. They have not yet registered them. Dr. Bloodgood, Dr. Ewing, and I should go over them and have a chance to express an opinion as to whether they are clearly cases of sarcoma. We may have a difference of opinion, but, at any rate, the data will be in the Registry for the use of future students of the subject.

Dr. Walter G. Stern, Cleveland: We, as practical surgeons, must be greatly indebted to the essayists and to Dr. Codman and his fellow workers, who have so boldly launched a new method of studying bone sarcoma. When one looks over the most recent literature of the subject, one is surprised to learn that there are so few authenticated cases alive after three or four years. Then, too, the various classifications are misleading. The speaker adheres to Ewing's classification, which seems the best. Taking Bloodgood's, which divides the growths into more benign central bone lesions and periosteal lesions, one would think that the former group, the central bone tumors, ought to show the better prognosis, but in reading over the literature one finds that the prognosis in that class of cases is almost as bad as in the second group, that of periosteal sarcoma. In periosteal sarcoma Bloodgood had only two cases alive after three years, and in the central bone lesions, he had seven cases alive at the end of five years, and the average duration of life in all cases was a little over one year.

Then, too, central sarcomata can change their characteristics and take on the attributes of the more malignant type as illustrated by a case recently under my care. A man, injured in an accident some eight years ago, soon afterward developed a growth in the upper end of the tibia that the older x-rays would lead one to believe to be a non-malignant central tumor. After eight years, the tumor suddenly grew rapidly larger, broke through the bone shell, and invaded the periosteum and cartilages. When I first saw him there were no metastases, and the leg was amputated above the middle of the thigh, after an exploratory incision proved the tumor to be a malignant one; but within eight weeks afterwards the man developed metastases, showing that what one believed, after careful study, to be a central tumor of non-malignant type, may be malignant and metastasize after operative interference. It might be well to raise the question whether such exploratory operation is justifiable, because, when one looks over the literature, one finds that they are followed in large number of cases by metastases or recurrences. Bloodgood advises that it be done with actual cautery or followed by cauterization with carbolic acid.

The work of Dr. Codman should be given our appreciation and thanks. Personally, he has helped me wonderfully to understand my cases and to take added interest in this work.

Dr. T. W. Harmer, Boston: The analysis of this little series of bone sarcoma developed two surprises. It is interesting that there are three cases of the osteogenic type in this series which have gone beyond the usual three year period. It is also interesting that despite the fact that an exploratory incision was made in several of these cases, curiously enough it did not seem to jeopardize the prognosis.

Dr. Packard, Denver: I was anxious to show some plates of a case of supposed osteosarcoma inasmuch as the case had been discussed by Dr. Cod-

man and also by Dr. Coley of New York recently. This boy was injured in September, 1919. The picture was taken afterwards, and there was no fracture or pathology of any kind. In January, 1920, x-ray showed some pathology and Dr. Codman has seen the photographs, but not the films. The photographs were rather unsatisfactory. The case clinically presented a large swelling, fusiform, on the upper portion of the femur, and the x-ray showed disease of the acetabulum, neck, head, and upper portion of the femur. About four months from the time of injury, pathologic fracture took place. He was treated, thinking it might be some inflammatory condition, with fixation and extension, with no relief. He was then started with the Coley's fluid, given under the direction of Dr. Coley, and improvement began in about two months from the time we began the injection of the Coley fluid. The improvement continued for about six months. The swelling went down, the pain disappeared, and he was practically well, with the exception of an ununited fracture. He has remained well for nearly two years, and the fracture united. We have not had any microscopic examination, but clinically it seems a typical case of osteosarcoma.

Current Orthopaedic Literature

THE OPERATIVE LENGTHENING OF THE FEMUR. Vittorio Putti. *Journal A. M. A.*, Sept. 17, 1921, p. 934.

Cases in which operative lengthening of the femur is indicated form a very limited series where the amount of shortening is greater that two inches and the disability is of old standing. Among these cases are old war fractures and others in which the shortening is due to a congenital or acquired cause, such as an acute epiphysitis of the head of the femur, where the process of normal growth has been seriously interfered with.

Among the problems of the procedure is the amount of traction the soft parts, muscles, nerves, and vessels can stand and the means actually to be employed. It has been proved that the soft parts can stand the strain of stretching and lengthening wihout detriment. Of the means to be employed, direct skeletal traction must be employed: it must be constant, measurable, and have a counter point in bone itself. The instrument devised by Putti goes by the name of an osteoton and consists of two large metal pins to be fixed just below the trochanter major and into the condyles. These stout pins can be inserted into the bone without previous drilling and are connected by a telescoping tube in which is a strong spring controlled by a screw. In addition, it can be used as a dynamometer and a measurer of length. The bone itself is cut by a motor-saw, at or away from the site of the old callus, by a Z-shaped incision like that used for tendon lengthening. The after-treatment is very simple and knee and hip may both be flexed on a pillow. The apparatus is left on for a month and replaced by a plaster. Consolidation is usually delayed.

Ten cases have been operated upon and integral lengthening of three-fourths of an inch obtained. In one case, the femur was lengthened beyond the normal proportions. No trophic disturbances have been noticed, though in one case the patient had pain along the course of the sciatic and femoral nerves.—*W. A. Cochrane, Boston, Mass.*

TREATMENT OF UNUNITED FRACTURES OF THE NECK OF THE FEMUR BY BONE TRANSPLANTS. Charles Davison. *Journal A. M. A.*, Sept. 17, 1921, p. 916.

Autoplastic transplantation of bone combined with external immobilization is the line of treatment for the repair of nonunion after fracture.

The author advises the use of a segment of fibula for the repair of ununited fractures of the neck of the femur. It combines an ideal size and shape, strength, elasticity, and lightness, and after removal of periosteum the irregular cortical bone with its osteoblasts lying free makes a graft rich in

bone forming potentialities. The site of fracture is exposed by the anterior route and the bone ends cleared of fibrous tissue as far as possible. An incision is then made directly over the trochanter major and both fragments drilled for the reception of the graft, which is inserted with the limb in abduction; the route is controlled through the original exposure. The hole that is drilled must be of smaller bore than the diameter of the graft.

Immobilization is obtained by a double plaster spica extending well up into the axillae and the limb is splinted in full abduction and external rotation. The abduction causes the muscle pull to approximate the fragments and the external rotation relaxes the muscles inserted into the trochanter major.

The writer then goes on to speak of the principles of bone growth that underlie the procedure with the stimulation to osteogenesis and callus formation between the fragments. The operation does not restore length nor motion that depend upon a femoral neck of normal proportions.

The operation is not indicated in old people on account of shock and the deleterious effects of prolonged immobilization.—*W. A. Cochrane, Boston, Mass.*

End-Results of Reconstruction Operation for Ununited Fracture of Neck of Femur. Armitage Whitman. *Jour. A. M. A.*, Sept. 17, 1921, p. 913.

The proportion of cases of fracture of the neck of the femur that fail to unite is still large and probably lies between the 15% of Campbell's statistics and the 100% of Delbet. In addition to its frequency, the disability resulting from pain and the possession of an unstable hip, incapable of weight-bearing, invests these cases with a special interest. The procedures employed hitherto in these cases have not had brilliant results and leave the patient very often after months of treatment still with nonunion The author passes in survey the methods of simple nailing by an ordinary steel pin, the use of tibial graft (Albee) or a fibular graft (Campbell-Delbet), and describes the development of operative scope and approach. They depend for success on ultimate bony union and this is an assumption not often borne out by results. In the large class of cases with destruction of the neck of the femur, union obtained by these pegging operations is gained at the expense of function, for when the hip is abducted the impingement of the top of the trochanter major on the ilium acts as a bony block.

Henderson, of the Mayo Clinic, shows 38% of good results in 26 cases, and Brackett found only one good result out of 24 cases.

The Whitman reconstructive operation is therefore applicable to cases in which the neck is absorbed and where bony union does not solve the functional disability. Neither does it depend upon the patient's inherent powers of osteogenesis.

The reconstruction operation removes the head of the bone. The trochanter major is chiselled off in a line continuous with the remaining portion of the neck. The surviving part of the neck is thrust into the acetabulum; the one bared by the removal of the trochanter provides a new neck. The trochanter is displaced downwards upon the shaft and attached to its denuded cortex by pegging or wiring. The muscles act so as to hold the end

of the femur within the acetabulum and resume their function as abductors and rotators. The limb is splinted for six weeks in a plaster spica.

Ten cases are reported and in all pain has been relieved and a stable weight-bearing hip obtained.—*W. A. Cochrane, Boston, Mass.*

Delayed Union and Nonunion of the Radius and Ulna. H. W. Meyerding. *Minnesota Medicine*, April, 1921.

Reconstruction surgery with restoration of function in delayed union and nonunion of the radius and ulna is made more difficult where the surgeon is confronted by the problems of deformity, infection, comminution, loss of bone substance, muscle degeneration, stiffness in neighboring joints, bone atrophy, impaired blood supply, and general constitutional disease. Another factor must be added to the causes of impaired union, that in which the process of ossification ceases from causes unknown before union is complete.

Imperfect reduction, inadequate fixation, and too early use were the chief predisposing factors in delayed union and nonunion of the fifty-nine cases reported.

Fixation must be carried beyond the elbow and beyond the wrist. It is highly important to make roentgenographic examination of all fractures before and after operation and at regular intervals while the patient is under observation. There is no fixed time for immobilization of the fracture, which time is based on the roentgenographic and clinical findings. If nonunion persists there is a resulting pseudo-arthrosis with fibrous union.

The cases considered as nonunion are those in which the fractures have failed to become firm within six months, and if less time has elapsed, delayed union is diagnosed. If syphilis is a possible factor, the opinion of a syphilologist is obtained, even though the Wassermann is negative.

The contraindications to operation must be considered. Infection must be adequately dealt with, sequestra and Lane plates removed, manipulation carried out, neighboring joints loosened up, the blood supply improved, bone atrophy overcome, and the general condition of the patient built up.

The massive graft, held by beef bone screws, and external fixation of plaster of Paris cast is the operation of choice. The graft is obtained from the tibia and is preferably larger in cross section than the excised half of the bone operated, so that new bone forms a bridge before the graft is weakened and when the danger of fracture is past. When the roentgenogram shows that strong, osseous tissue has formed, careful increase in use of the limb may be carried out. Light massage and careful exercise on removal of splints aid in improving circulation and loosening up stiffened parts. The splints may be removed during the day and applied at night in order to prevent injury during sleep.

Nonunion in the Radius and Ulna.

(Mayo Clinic, May, 1913, to June, 1920.)

Patients (54 males, 5 females)	59
Patients operated on for nonunion before examination at the Clinic (one had had seven operations), (54.4 per cent.)	32
Average age (oldest patient 78, youngest patient 8) years	33
Average time since fracture, months	15
Longest time since fracture, years	19

Site of Delayed Nonunion.

Radius and ulna (right 28, left 19)	47
Radius (right 5, left 3)	8
Ulna (right 1, left 3)	4

Operations.

Lane plate	6
Bone graft	31
Removal of Lane plate (three plates applied at Clinic)	8
Drainage for infection	10
Sequestrectomy, manipulation and so forth	4

Bone-graft Operations.

Patients (29 males, 2 females)		31
Average duration of nonunion (months)		22.2
Nonunion in radius and ulna (right 7, left 3)		10
Good union	4	
Improvement (ulna only united)	2	
Failure	1	
Information not obtained	3	
Nonunion in radius (right 10, left 8)		18
Good union	13	
Improvement	1	
Failure	1	
Information not obtained	3	
Nonunion in ulna (right 1, left 2)		3
Good union	1	
Information not obtained	1	

Results of Operations.

Patients from whom information has been received		34
Good union	25	
Failures	7	
Improvement	2	
Patients whose operations are too recent to include in results		7
Patients from whom information could not be obtained		18

—*S. Brock, Rochester, Minn.*

DOWNWARD DISLOCATION OF THE PATELLA. H. Rutherford. *British Journal of Surgery*, April, 1921.

The author has previously reported a case of dislocation downward of the patella. In this paper two other similar cases are reported; one in a man 42 years, and one in a boy 7 years of age. Each received a blow on the patella with the knee partially flexed, which was followed by immediate disability, pain, and swelling.

In the adult it was noted that the patella formed an unusual prominence between the femur and the tibia. The x-ray showed that the upper surface

of the patella was caught between the articular surfaces of the femur and the tibia, and the bone rotated so that the anterior surface pointed upwards; also that part of the superior edge of the patella had been torn away and remained with the quadriceps tendon.

This tends to confirm the view that upward and downward dislocation can only occur when associated with other lesions, particularly rupture of the quadriceps tendon or the patella ligament.

Reduction was accomplished by open operation. The final result in each case was satisfactory.—*J. I. Mitchell, Rochester, Minn.*

CASE OF PARAPLEGIA IN WHICH THE SECOND CERVICAL VERTEBRA WAS REMOVED: WITH A NOTE OF THE PATIENT'S CONDITION SEVENTEEN YEARS LATER. J. Hogarth Pringle. *British Journal of Surgery*, April, 1921.

Case of a boy, age 14, in Royal Infirmary, May, 1903. Complete paraplegia, except not absolute in left leg. Previous history of enlarged glands of neck, age 12; pains in head; weakness of left side two months before, attributed to a fall. Examination on entrance showed severe pain and tenderness in neck, with complete paraplegia except slight movements possible in left leg. Normal knee-jerks, ankle clonus, negative Babinski, retention of urine, and a fluctuating, tender swelling over whole cervical spine. Operated and the pus drained off and wound packed. Laminae of first three cervical vertebrae were found bared by the pus and the second vertebra was entirely necrosed. Next day the paraplegia had almost disappeared. One week later bladder and rectal symptoms ceased. Month later, abscesses formed on each side of neck and were opened, drained, and a part of first, all of second, except odontoid process, and upper part of third cervical vertebrae were removed, left vertebral artery cut but right was left intact. Three months elapsed and patient was discharged apparently recovered.

Seventeen years later patient again presented himself with almost same symptoms, except left lower leg was worse and also numbness in extremities in addition. Had worked as a riveter up to this time. Examination showed exaggerated knee-jerks, negative Babinski, no disturbance of sensation, clonus, neck shortened but no angular deformity. However, neck could not be rotated. Weak grip in both hands. X-ray showed absence of two cervical vertebrae.

Two months' extension to spine increased grip of hands to 80%. Five months later patient was seen and condition was better than original. No disturbances of sensation, but poor stereognostic sense. Original diagnosis of Pott's, but changed to subacute osteo-myelitis.

Today there is no deformity outside of shortening of neck.

Author states the most interesting point was how spine was shortened and cord accommodated. *E. Ashbury, Rochester, Minnesota.*

EFFECT OF POSTURE ON THE HEALTH OF THE CHILD. Frank D. Dickson. *Jour. A. M. A.*, Sept. 3, 1921, p. 760.

This article describes correct posture and emphasizes its effect upon physical and mental development. He quotes Goldthwait, Brown and Talbot, D. P.

Willard, and others, and gives his experience with 48 cases observed long enough to allow some conclusions to be drawn as to symptoms and results. There are five illustrations, one showing a back brace which he uses. His conclusions are as follows:

1. Poor bodily mechanics may often explain why a child is not enjoying the health and development it should, and may even explain acute conditions which may be affecting it. Therefore, a careful examination of posture should be a part of every medical examination, and the correction of postural faults, when found, should be insisted on.

2. Coöperation between the pediatrician and the orthopædist should be close in the care of these patients. In childhood, the correction of faulty posture is comparatively easy, and if these two work together, they should be able to prevent the bad effects which may follow its non-correction.

3. The child is but the forerunner of the adult. Its conformation forecasts what manner of man will result when maturity is attained, and hence, for the future welfare of the individual, posture in childhood becomes important.

—*F. G. Hodgson, Atlanta, Ga.*

INTERMITTENT HYDRARTHROSIS. Walter L. Bierring. *Jour. A. M. A.*, Sept. 3, 1921, p. 785.

A case is reported in detail, a man of thirty-six years who was observed over a period of five years. The swelling of the knee would begin, reach its height on the third day, and return to normal on the sixth day, then after an interval of exactly 12 days, the exact same cycle would be repeated. Later the other knee became involved with a cycle of five days and free interval of eleven days. The hydrarthrosis occurred with "clock-like regularity."

An historical summary, pathogenesis, and theories as to the nature of the process are given. References to 76 similar cases reported in the literature are given. No autopsies have been reported. The disease often continues without interruption for a long period of years. There is a distinct tendency to remissions or prolongation of the interval between attacks, and the ultimate result is favorable. No form of treatment seemed to have any decided curative effect.—*F. G. Hodgson, Atlanta, Ga.*

THE ILIOSACRAL JOINT. H. R. Allen. *Jour. A. M. A.*, Sept. 10, 1921, p. 854.

Both comparative and human anatomy of the pelvic girdle are discussed; also the action of the sacroiliac and pubic joints. Author suggests that the entire pelvis be taken in making roentgenograms, to show the relation of the pubic bones to the sacroiliacs. A better suggestion would have been stereoradiograms taken with a Potter-Bucky diaphragm. He suggests, in regard to treatment, grasping the crest of the ilium, or the pubes, or the ischial tuberosity on each side of the body for manipulation in the reduction of fractures or dislocation. Also through the rectum a firm grasp can be taken on the lower end of the sacrum.—*F. G. Hodgson, Atlanta, Ga.*

Scoliosis Ischiadica Alternans. A. Blencke. *Archiv. Orthop. und Unfall-Chir.*, Vol. xviii, 1-2, September, 1920.

The author quotes twelve cases in the literature showing alternating tilting of the body in sciatica. It is impossible to unite all symptoms into a common syndrome. In the cases in which the alternations of posture are involuntary, the clinical pictures have this in common: that the disease of the nerves was regularly extended to the lumbar region. Voluntary alternation could not be obtained in any of these cases. On the other hand, the cases in which there is voluntary change from contralateral scoliosis into homolateral scoliosis and *vice versa* have this in common, that the change of the lateral deviation is usually observed only after the acute symptoms of sciatica have disappeared and the trouble has persisted for some time.

To all cases is common, the presence of a sciatica, and in the course of the latter the lateral and often also the antero-posterior curves develop. Considering the complexity of the sacrolumbar plexus, the author points out that the neuralgias of the different sensory tracts of the lumbar and sacrolumbar plexus, also have different syndromes, which, however, cannot yet be sharply defined from each other and which often melt into each other, probably because of the intimate relations of their respective cortical and sub-cortical centers. In the opinion of Hoffa, the deviation of the spine is due to a reflex contracture. He himself suffered from severe sciatica and stated in his own case that the scoliosis occurred suddenly and was accompanied by subsidence of pain.

Lorenz concludes that the lumbar spine is bent reflexly by muscle spasm, with the convexity pointing to the affected side, in order to save the afflicted lumbar and sacrolumbar nerves from painful tension. The whole external picture of the trouble is built upon the lumbar curve as the basis. Lorenz then proved mathematically that in lumbar scoliosis with convexity to the diseased side, a minimum of tension of the lumbo sacral nerves occurs if the trunk is tilted contralaterally. On the other hand, if the lumbar curve points with its convexity to the sound side, a relaxation of the nerve plexus can only occur if the trunk is tilted to the affected side. Thale comes to the following conclusions based upon the anatomy of the plexus: A homolateral scoliosis occurs when the three sacral roots are involved and when in relaxing the latter the pelvis is dropped on the affected side; an alternating scoliosis occurs when all roots are involved and now the ones and now the others are being relaxed. The scoliosis is missing when the fifth lumbar nerve is involved.

A valuable contribution to the doctrine of sciatic scoliosis is given by the studies of Ehret of a group of cases with alternating scoliosis. The pain in the lumbar plexus automatically leads to homolateral and the pain in the sacral plexus to contralateral scoliosis. Ehret considers as an initial stage the still rarer cases of voluntary change of positon. All other changes which the different cases go through in recumbent position, in suspension, in forward bending of the body, can be explained easily by the fact that the relaxing agents of one type disappear and are immediately substituted by others. The many possibilities of relaxing the diseased nerve also explain the variety of the single individual histories. The greater possibility given by nature to shorten the nerve, the more variegated and different are the cases from each other.—*A. Steindler, Iowa City, Iowa.*

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The Journal *of* Orthopædic Surgery

NOTICE TO READERS

The answers received from members of the American Orthopedic Association and other readers of the JOURNAL OF ORTHOPÆDIC SURGERY to the notice inserted in the August number of the Journal in reference to a change in form from a monthly to a quarterly publication have been so overwhelmingly in favor of the latter that the Executive and Editorial Committees of the Association have decided to make the change beginning with the January issue.

At that time the name will also be changed from THE JOURNAL OF ORTHOPÆDIC SURGERY to THE JOURNAL OF BONE AND JOINT SURGERY —THE MECHANICS OF FUNCTION.

In issuing the JOURNAL every three months it will be possible to present to the readers fully as much, or even more, reading matter than under the existing arrangement, and it is hoped that the JOURNAL may be made more valuable and interesting.

EDITORIAL DEPARTMENT

FOREWORD FOR THE YEAR 1922.

BEGINNING with the succeeding issue, the JOURNAL will be changed to a quarterly publication. This decision was arrived at by the Executive and Editorial Committees after deliberate consideration, and after

having received a large number of opinions from subscribers, which were almost unanimously in favor of this change. It is believed that, in this form, the material can be so presented that it will be of much greater value to the readers of the JOURNAL, and we are asking the coöperation of all to aid in making this change a success.

Also, with this issue, the JOURNAL will appear under a new name. The title of "THE JOURNAL OF ORTHOPAEDIC SURGERY" will be replaced by "THE JOURNAL OF BONE AND JOINT SURGERY—THE MECHANICS OF FUNCTION." It may be said, and truly so, that this mantle will not cover all of the contents which will be placed under its shelter, but this would be quite as true of any title which might be selected, and certainly is it so of the term "Orthopædic Surgery." The Committee has decided upon this name after careful consideration, and believes that it will best designate, in general, the department of surgery which will be represented by the class of papers and subjects which come naturally under its publications.

The question will naturally arise as to the reason and the advisability for the change in name, particularly to one that is not perfect. It is in accordance with a broader understanding of what specialties actually are, and of the position that they should occupy in relation to the art of medicine and surgery.

The scope of a specialty in surgery, with its many ramifications and inter-relations with allied branches, is not a problem which can be settled by an arbitrary division of work. As orthopaedic surgeons, we can make no definite boundaries of inclusion or exclusion, and it is fortunate that such is the case. The position of orthopaedic surgery, and the work of orthopaedic surgeons, varies so greatly geographically, that even for this reason alone, it is impossible to make a division of work which would be equitable to the patient. A specialty demands of its members that they shall be equipped in the different features of treatment which are necessary for the complete care of cases which come under a special grouping,—based on the fundamental knowledge of medicine and surgery, with the added special experience required by any group of cases to which these added features of treatment must be brought.

The demands which orthopaedic surgery must make today are demands upon its members and upon those who interest themselves in developing and perfecting the care of cases which fall under special forms of treatment. The special knowledge necessary is that which pertains to the joint and osseous system, with the allied subjects such as the mechanism of motion; the means and methods necessary

to prevent and to correct deformity; the principle of mechanics as applied to the body (which includes the application of apparatus); the special care in the long post-operative period; and the preservation and early return of function of the locomotive apparatus of the body.

The responsibility for a man's recovery must continue until he is finally replaced in his working status, and the last step in the process of restoration is fully as important as the first step,—which may have been the primary operation. Specialization has brought into prominence the important feature which is beginning to be recognized as an essential in specialization:—namely, the responsibility of the surgeon to so fit himself by knowledge and experience that he may assume the responsibility of all of the phases of treatment during the course of the special cases. This is particularly applicable to that large group of cases which comprise the surgery of bones and joints, etc. Not only must the surgeon who plans to put emphasis on the later treatment—including the various forms of therapy which are directed toward restoration and preservation of function—be qualified for the operative treatment of this case, but it is equally important that a surgeon who performs or takes charge of the preliminary operative treatment be qualified to take the responsibility and direction of all steps in that post-operative period, which may be prolonged, and which may involve mechanical treatment and various forms of restorative therapy. This is important, because it is impossible to divide or transfer the responsibility of control in any stage of the course of treatment without detriment to the patient, and without the loss of that professional interest which is essential to the best results.

As orthopaedic surgeons, our aim is to standardize the requirements of orthopaedic surgery, and to recognize as orthopaedic surgeons those who have qualified to these standards. Our concern is, not with the special grouping of cases, etc., which are to be placed within certain boundaries in the field of surgery or medicine, but rather with the requirements which should be demanded of the men who enter any of these special fields of work—which have more or less of natural boundaries or limits. With special knowledge and experience, cases requiring this equipment will naturally so group themselves as to derive the benefit from it.

By this title of the JOURNAL, we may indicate the subject-matter which should have particular attention by those interested in this

group of cases, and may attempt to furnish material which will be of aid in the equipment of the knowledge of the treatment of such cases. With this change of the name, we trust there will be taken one of the steps to establish specialties in their intimate and true relation to the art of treating by medicine and surgery, the specialty defined rather by the special skill and knowledge possessed by its members, than by an arbitrary division of the field in which they may be placed to work.

Original Communications

OPERATIVE METHODS AND END-RESULTS OF DISABILITIES OF SHOULDER AND ARM.

BY ARTHUR STEINDLER, M.D., F.A.C.S., IOWA CITY, IOWA.

LIMITATION of space and time have made it necessary for the writer to select among the numerous operative methods applied in orthopaedic ailments of the upper extremity a smaller group only and to present with all possible briefness the principal points of technic and the operative results. The latter are not, in the strictest sense of the word, results of operative interference as such, but those of a treatment in which operation is an essential, but not necessarily the most important, factor.

The results are measured by function rather than by anatomical realignment. Functional results are not presented by photographic records alone, but also by the physiotherapeutic records of the after-treatment, which express in graphs and curves the progress attained during the course of this treatment.

The writer is aware of the fact that in matters of technic any of the methods described may be substantially improved; it is felt, however, that the present stage of development of orthopaedic surgery of the upper extremity, it is the problem of therapeutic principles at large in which criticisms and suggestions will be most helpful.

Fig. 1.

Fig. 2.

Fig. 3.

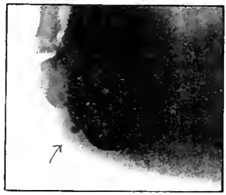


Fig. 4.

Figs. 1, 2, and 3.—Manipulative correction.
Fig. 4.—Calcareous deposit.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

Figs. 5 to 9.—Birth palsy. Sever's operation. Reduction of dislocation.

A. Operations for contracture deformities of the shoulder.

1. Manipulative correction of the adduction and inward rotation: The contracture develops in the wake of certain extra articular lesions; following splint fixation, sprains and tears of the adductors, traumatism to the shoulder, in the milder degrees of birth palsy, and especially in subdeltoid bursitis.

Of the latter group 11 cases were treated; 5 cured, 5 improved, 1 not improved.

Manipulative correction is carried out under anaesthesia without any application of force. The position of abduction and outward rotation of the shoulder is secured by a so-called aeroplane splint. After-treatment begins two to three days after manipulation. The degree of abduction is slowly (Dunlop) lessened, *pari passu* with the redevelopment of deltoid function, the angle of the splint being changed in accordance. The average time of treatment in this series of cases was three months. Brickner's open operation was performed in two cases, but no calcareous deposits were found in the supraspinatus tendon (Figures 1, 2, 3, 4).

2. Tenotomies of abductors and inward rotators of the shoulder. Sever's operation. The shoulder contractures developing in obstetrical paralysis not yielding to manipulative stretching form the indication for this method. The technic is generally known. The tendon of the contracted subscapularis muscle is reached from an incision over the inner border of the deltoid and by bluntly proceeding between this muscle and the lateral border of the pectoralis major. In addition to the subscapularis tendon and that of the pectoralis major, the tendons of the short head of the biceps, the coraco-brachialis and of the latissimus dorsi must occasionally be sectioned.

Of eleven cases treated, manipulative correction was applied in five, and open operation in six cases. Of the latter, two belonged to the upper arm type and four to the whole arm type. Posterior dislocation of the head of the humerus, present in two cases, was reduced by manipulation in one case, and by open operation which included the resection of the overhanging acromion in the other.

Results of the operative cases: good in four, fair in one, and undetermined in one case (Figures 5, 6, 7, 8, 9).

B. Arthrodesis of the Shoulder.

This procedure is indicated in the permanently flail shoulder, in deltoid paralysis from anterior poliomyelitis, not remediable by con-

servative treatment; in traumatic ankylosis in malposition, with defect or atrophy of the deltoid muscle.

Technic: Incision is made from the spine of the scapula in an arc which circles the acromions and ends anteriorly over the coracoid process. The skin-fascia flap is prepared upward high enough to expose the edge of the acromion for a distance of 1 inch to 1½ inch. The fibers of the deltoid muscle or its remnants are separated bluntly at lines corresponding to the middle portion, the acromion is incised transversely ¾ to 1 inch from the free edge, cut through with the osteotome, and the flap containing bone and deltoid muscle is turned downward. This brings into full view the lateral aspect of the capsule. The latter is opened by longitudinal incision and the edges of the cut are grasped carefully by forceps and are retracted. The tendon of the long head of the biceps appears, antero-internal to the incision, within the capsule. This exposure of the joint allows complete denudation of the articular ends. For the head of the humerus, this may be facilitated by pushing it through the incision in the capsule out into the wound. Two silver wires are passed through both head and overhanging portion of the acromion. The slack in the capsule is taken up by transverse suturing of the longitudinal slit and the silver wires are then tied over this suture.* Fixation is carried out by a plaster cast with the arm abducted at right angle, inwardly rotated and elbow flexed. The cast remains for two or three months, at the end of which time it is replaced by a platform splint. Then follows the after-treatment, which consists of massage, exercises, and arm-raising drills.

It is unnecessary to wait with the arthrodesis of the shoulder until the fourteenth to eighteenth year, as advocated by Lange. One must consider that the problem of dealing definitely with the flail shoulder often arises in very young children in whom the loss of eight to ten years, spent in waiting, is sure to result in considerable retardation in the development of the whole extremity. Sir Robert Jones advocates arthrodesis at as early an age as six to eight years, and Vacchelli lately reported an operative series with five years as the earliest age.

Right angle abduction was the position of choice. Some authors favor a lesser degree of abduction (Lange). In the writer's series there existed no difficulty in bringing the arm into adduction position; there is, however, a decided tendency to develop scoliosis, and preventive measures must be taken early. Shoulder exercises are combined with corrective gymnastics in the after-treatment.

* Wire sutures have since been substituted by heavy chromic catgut.

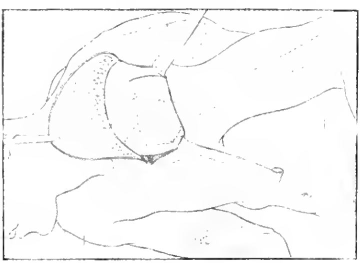


Fig. 10.

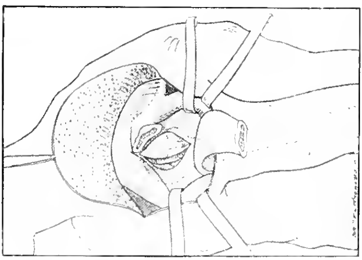


Fig. 11.

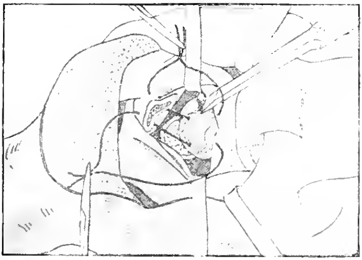


Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

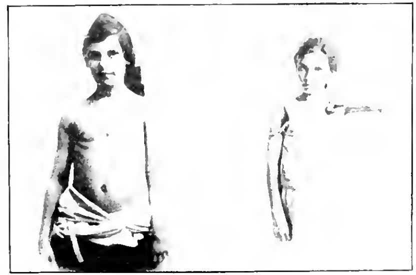


Fig. 16.

Fig. 17.

Figs. 10 to 17.—Arthrodesis of shoulder. Technic and operative results.

Arthrodesis of the shoulder was performed in 19 cases; eight of these cases showed bony, and seven fibrous ankylosis, while in four cases the type of ankylosis was not determined. The operation was done either alone (six cases) or combined with flexor-plasty of the elbow (five cases), with arthrodesis of the wrist (two cases), with tendon transplantation of the wrist (one case), or with both elbow-plasty and arthrodesis of the wrist (four cases).

The age of the patients varied from six to twenty-seven years; the time of observation following operation, from four to fourteen months. The results (functional) were good in fourteen cases, fair in two cases, and undetermined in three cases. The good results had active abduction ranging from 65 degrees to 120 degrees, the fair cases from 45 degrees to 65 degrees. The curves obtained from the arm-raising drill show percentually the functional gain. The base line (100%) represents the functional value of the other (intact) extremity. (Figures 11, 12, 13, 14, 15, 16, 17.)

C. The Muscle Transposition at the Elbow of Forearm Flexors (Flexor-plasty of Elbow).

The indication for this procedure arises in cases of flail elbow. The method is devised with the object of furnishing some limited flexion power for the flail elbow.

Technic: An incision is made starting three inches above the internal epicondyle of the humerus between the inner border of the brachialis anticus and triceps muscles. It is carried downward to the epicondyle and is continued from this point in an obliquely downward and outward direction over the anterior aspect of the forearm. The ulnar nerve is located and retracted backward, the common origin of the pronator teres, flexor carpi radialis, palmaris longus, and flexer carpi ulnaris muscles is then carefully dissected off the internal condyle. In so doing one must be careful not to injure the nerve supply which reaches these muscles from below. But one and one-half to two inches of the muscle mass may be freed safely. This muscle flap is then lifted up and inserted two inches higher up into a point of the inner intermuscular septum between the brachialis anticus and triceps muscles. A position of acute flexion in the elbow is maintained for not less than two months. After two or three weeks, however, the cast applied at operation may be replaced by a splint having the proper angle so that the after-treatment, consisting in massage and exercises, may begin at this time.

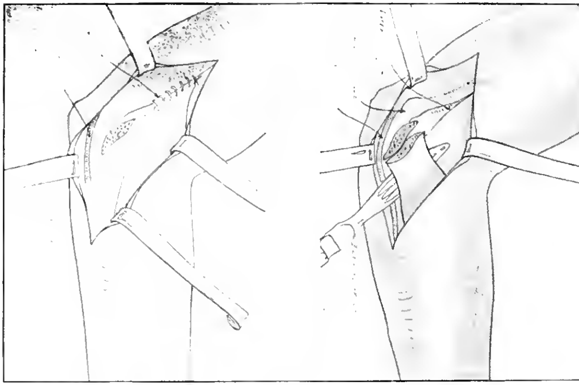


Fig. 18.

Fig. 19.

Fig. 20.

Figs. 18 to 20. Flexor plasty of elbow. Technic and operative results.

This method was employed in 17 cases. The ages of the patients ranged from four to twenty-one years; the duration of the paralysis from one to thirteen years. The time of postoperative observation varied from three months to three years.

In six cases this operation was performed alone; in five more it was combined with arthrodesis of the shoulder; in five cases with arthrodesis of the shoulder and wrist, and in one case with arthrodesis of the shoulder and tendon transplantation at the wrist.

The results (functional) were good in nine cases, *i.e.*, active flexion of the elbow in any position was obtained; fair results were obtained in three cases (flexion of the elbow in horizontal position only), and poor results (no flexion) in five cases.

The best results were obtained where this method was combined with arthrodesis of the shoulder. Cause of failure was generally a weakened condition of the flexor muscle used for transposition, and it must be emphasized that a degree of integrity of these muscles is essential for the success of the method (Figures 18, 19, 20).

D. Plasty of the Forearm Muscles. Twenty-eight Cases.

Indications: Pronation and flexion contractures at the elbow and wrist in ischemic myositis, in spastic contractures, in traumatic contractures, in contracted clubhands, etc.

1. Flexor-plasties. Technic: The forearm flexors are dissected from an extended longitudinal incision running along the middle of the volar surface of the forearm. The tendons are isolated and individually lengthened, being incised Z-shape fashion, which permits the split portions to glide along beside each other until the desired length is reached. As much as possible the fascial compartments are reconstructed.

2. Resection and myotomies of the pronators in pronator contraction. The pronator radii teres is reached from an oblique incision starting at the internal epicondyle and following the direction of the pronator teres in its downward and outward course. The pronator quadratus is reached from a mid-volar incision over the lower third of the forearm.

Flexor-plasty was applied alone in 13 cases; combined with pronator resection in two cases; with extensor-plasty of the thumb in two cases; with arthrodesis of the wrist in three cases.

FIG. 21.

FIG. 22.

FIG. 23.

FIGS. 21 to 23.—Forearm muscle plastics.

FIG. 21.—Ischemic contracture.

FIG. 22.—Traumatic contracture.

FIG. 23.—Spastic contracture. (Pronator resection.)

Pronator resection was performed alone in five cases, combined with flexor-plasty in two cases, and with arthrodesis of the wrist in one case.

The results (functional) were good in 17 cases, fair in nine cases, and poor in two cases (Figures 21, 22, 23).

E. Arthrodesis of the Wrist. Twenty-five Cases.

The indication for this operation was given in cases of flail wrist following infantile paralysis; in drop wrist following peripheral paralysis; in spastic contractures of the wrist and in ankylosis of the wrist in faulty (flexion) position.

Technic: A dorsal incision is made over the wrist between the tendons of the extensor pollicis longus and extensor proprius indicis. The lower end of the radius as well as the scaphoid and os lunatum are exposed. A wedge-shaped piece of bone with dorsal base is resected from the articular surfaces of radius, scaphoid and os lunatum. The position of the wrist is secured in dorsiflexion by sutures passed through drill holes in the bones. A cast is applied reaching from the metacarpo-phalangeal joints to midway between shoulder and elbow. It is allowed to remain for two to three months.

In the 25 cases operated upon the ages ranged between six and twenty-six years. The duration of the condition varied from six months to fifteen years; the time of postoperative observation from two months to eighteen months.

Arthrodesis of the wrist was performed alone in ten cases, combined with arthrodesis of the shoulder in two cases, with tendon transplantation of the fingers in three cases, with forearm muscle plasty in two cases; with arthrodesis of the shoulder and elbow-plasty in three cases; with extensor-plasty of the thumb in two cases; with arthrodesis of the shoulder and flexor-plasty of the thumb in one case; with pronator resection in one case, and with Stoffel's operation in one case.

The results (functional) were good in 14 cases, fair in five cases, poor in four cases and undetermined in two cases (Figures 24, 25, 26).

In paralytic cases, arthrodesis was given preference over tendon transplantation of the wrist, since the cases were few in which there was enough muscle material available to insure both function of the wrist (motion as well as stability) and function of the fingers.

The most favorable results seem to be obtained where different methods were used in combination. This was especially the case in combination of shoulder arthrodesis with flexor transposition at the

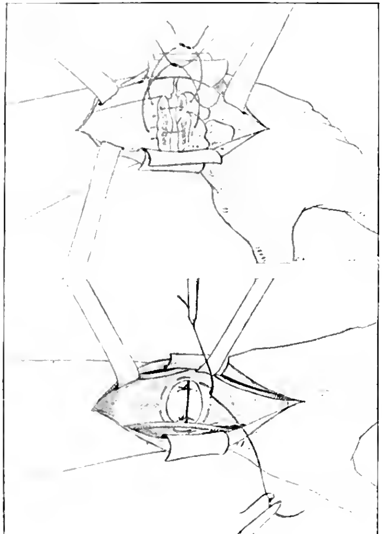


Fig. 24.

Fig. 25.

Fig. 26.

Figs. 24 to 26.—Arthrodesis of wrist. Technic and operative results.

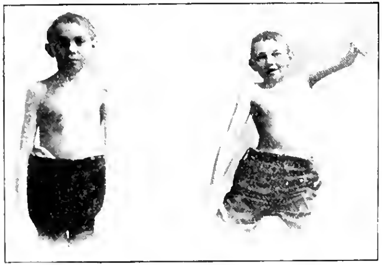


FIG. 27.

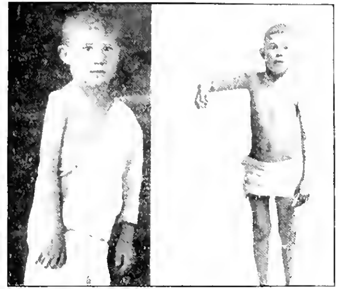


FIG. 28.

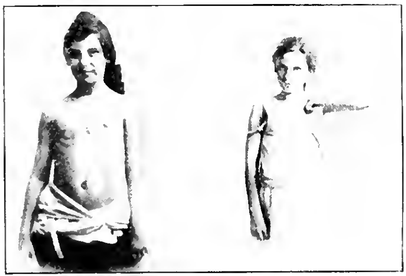


FIG. 29.

FIGS. 27 to 29.—Combinations. Arthrodesis shoulder—elbow plasty—arthrodesis wrist.

elbow, the former method procuring the horizontal elevation of the arm in which the elbow action asserted itself to better advantage; it was also true of the combination of these two methods with arthrodesis of the wrist, and of the combination of arthrodesis of the wrist with tendon transplantation of the fingers (Figures 27, 28, 29).

DISCUSSION OF DR. STEINDLER'S PAPER.

DR. OSGOOD: Gentlemen, you have heard this very careful review of significant work. Permit the Chair to say that he has observed Dr. Steindler's work on the ground, and that it is most valuable, hopeful, and skillful. The discussion is to be opened by Dr. J. W. Sever.

DR. JAMES W. SEVER, Boston: I was much interested in Dr. Steindler's paper and his admirable results. I want to say a word about manipulations on the shoulder. I find that it is apparently the fashion now to give up operating on subdeltoid bursae, and that manipulation, fixation, and traction in bed, even if there are deposits in the bursa, are used, and that there have been obtained as good results by that method.

In regard to the stretching operation for definite muscular contraction of the shoulder joint, secondary to obstetrical paralysis, I have not been successful with it because it depends on the fixation of the scapula so much that manipulation, forceful or otherwise, without that fixation, is apparently not very successful. I think that the after-treatment of any of these cases is of paramount importance, particularly in the cases not operated on—not, of course, where there has been an arthrodesis, but where the patient has had a muscle transplantation or a tenotomy. It has been our practice, when there have been cutting operations about the shoulder, to start on exercise as soon as the wound is healed, about the seventh or eighth day. Prolonged fixation without early motion has given us very poor results. In two of the early cases in our series of obstetrical paralysis, we put the plaster casts on the children and had their arms fixed in the abducted and fully supinated position for six weeks, and we had, and still have, a beautiful arthodesis of the shoulder joint. Dr. Steindler spoke of dividing the muscles; in these cases of paralysis, the ultimate result would not be good, he said. The result will be good, because gravity is working with it. We have in some of the later cases, where there has been considerable contraction, often taken off the coracoid process from the scapula. In a few cases, we have found it necessary to divide the acromion, because of posterior subluxation of the shoulder. That has been done in only a few of the older cases. Posterior subluxation when existing, has been the result of long standing contraction.

I was rather surprised at the position of the shoulder in regard to the arthrodesis. I have always been taught that it was better to have the shoulder not at a right angle and carried forward in this plane. As a matter of fact, the result was good The play of the scapular muscles with gravity takes care of the position; and in the two cases following infantile paralysis, the parents were well pleased, and both children were better. Their function was better but their arms were outwardly rotated, rather than inwardly rotated, which did not make the ultimate position so good.

In connection with obstetrical paralysis cases, we found that the greatest factor in failure to obtain full function of the shoulder was lack of early motion.

DR. EMIL GEIST, Minneapolis, Minn.: Dr. Steindler is a pioneer in the question of tendon operations on the upper extremity, and I cannot join in the discussion, because my experience is not extensive enough.

Regarding subdeltoid bursitis, I will substantiate what Dr. Sever has said. I have stopped operating on these cases, for two patients who had these cal-

careous deposits and who refused operation got well, not only clinically, but also the calcareous deposits disappeared as time went on, as was shown by the x-ray. Dr. Steindler's paper shows that arthrodesis of the shoulder is an extremely satisfactory operation. Dr. Steindler's method of approaching the joint is a genuine advance.

Regarding the question of ischemic contractures, I was surprised at the uniformly good results which Dr. Steindler obtained following extensive lengthening of the various tendons on the flexor surface of the forearm. My experience has not been so good in this type of operations. Those cases in which we achieved good results, were done by the method shown by Sir Robert Jones at the last meeting of the Orthopedic Association that he attended, in 1910,—the method of gradual correction.

In arthrodesing a wrist, I do not only what Dr. Steindler does, but also what Dr. Ely does, put a bone graft into one of the metacarpals, cross the wrist, and include the lower end of the radius.

Sir Robert Jones, Liverpool, Eng.: While it does not very much matter in the child how extreme the abduction of the arm in arthrodesis, in the adult it does. In the child the scapula is so accommodating that the arm can be brought to the side. In the adult if abduction is extreme, the patient will never be able to bring his arm to his side. This is a most objectionable deformity. I hesitate very much before I arthrodese an adult arm for paralysis of the deltoid. This is especially the case in women who want to do their back hair and fasten their dresses. These women with paralyzed deltoids are very handy with their arms, for they place the hand of the bad arm into position, either by a swing or by means of the other hand.

Dr. Walter G. Stern, Cleveland: There are very few operations that have given me as gratifying results as the ones Dr. Steindler describes. It is amazing and surprising to see what the children can do with their shoulders after an arthrodesis has been performed.

I have given up the open operation for subdeltoid bursitis, because twice I have had the following experience: The x-ray showed what seemed to be calcareous deposits in the infraspinatus tendon, and upon excising these I found the deposits were soft, yellow, cheesy masses. The pathologist reported that the condition was a form of adipocere, or pure chemical fat deposits that had been changed. That is why we can see supposed calcareous deposits in this region appear and disappear so suddenly under local treatment, without any operative interference whatsoever.

Dr. Fred H. Albee, New York City: In regard to the question of position after arthrodesis at the shoulder, I would say that I have done a large number of arthrodeses at the shoulder, and can confirm what others have said, that it is a very satisfactory operation. Success following this operation is very largely dependent upon fixing the arm in such a position as will allow scapulo-thoracic motion to compensate for the loss of motion at the shoulder joint. This is best accomplished by arthrodesing the joint with the upper arm in a posture of anterior elevation at right angles with the trunk, with the scapula in a neutral position flat against the chest wall. The humerus should also be rotated at the shoulder, so that the forearm, when flexed at the elbow, is directed upward. I have devised my Fracture Orthopaedic Table so that the upper extremity can be held in this posture with or without traction throughout the operation and the application of the post-operation plaster-of-Paris shoulder spica. It seems that the most important function is the ability to bring the hand to the midline of the body, the hair, the mouth or the necktie. The posture, which I have been using for some years, and herein described, restores function more completely than any other.

I cannot see the wisdom of using metal wire as a fixation bone ligature. I cannot see why heavy kangaroo tendon would not do as well and hold as

long. Putting in a peg graft through the acrominon process and into the humeral head would hasten union and be an advantage, because confinement by immobilization splints would thus be reduced.

Dr. Arthur Steindler, Iowa City: I am much more concerned with principles at this stage of the game than with technical details. I should be very glad to adopt any modification of the technique, which I know to be incomplete from every angle.

With regard to the position that the arm should be given in arthrodesis, I should not care to give it outward rotation, because I do not know what muscles could take care of the inward rotation after the arthrodesis is completed. I realize that it is perfectly true that in adults the range of the shoulder motion is less than in children, and abduction must be less than 90 degrees. In children, I felt that the angle of 90 degrees was permissible.

PRESENT TENDENCIES IN THE TREATMENT OF CONGENITAL CLUB-FOOT.

BY EBEN W. FISKE, A.M., M.D., PITTSBURGH, PA.

Regardless of the abundance of literature on the subject, very little that is essentially new in the treatment of congenital club-foot has been advanced in the last thirty years. Moreover, the trend of treatment has been by no means universal, although certain aspects have gained favor at intervals—the brace method, largely used in the pre-operative days, the corrective operation, and the essentially non-operative, manipulative treatment. The latter two, at least, are in present use, although their underlying principles are essentially divergent. The question naturally arises if long-standing, fundamental theories have not yet been proven out by practice, and if between these methods there does not lie a definitely indicated choice. It has seemed that the collective opinion of representative orthopædists, based on a questionnaire, might offer some guidance in this direction. Sixty-six replies were received and have been numerically compiled in answer to each question.

The first question, "At what age do you prefer to begin treatment of congenital equinovarus?", found 90% in favor of beginning in the first month of life, and three-fourths of these in the first week. Only four men would wait longer than three months. In reply to the second question, "What method do you employ in your youngest cases?", all manipulate in the beginning, all but three following with fixation,

plaster of Paris being used by the majority—40. First treatment under anesthesia is used by three men, two of them operating. The preponderance of opinion in favor of immediate treatment of the newborn child, whenever possible, and of the manipulative or non-operative method at this age, is therefore obvious.

The third question brought the age limit to six months, with the query, "Under what conditions do you use tenotomy and forcible correction with anesthesia in cases under six months?" The replies to this question may be placed under three groupings: those who employ these methods only in exceptional circumstances, those who use them much more freely, and those who are opposed to them at this age. In the use of tenotomy, fourteen employ it for severe cases, twelve for a resistant tendo Achillis, and five would tenotomize if the patient came from a distance. Three would divide the tendons if the condition were moderately severe, one usually does, and one always does. On the other hand, twenty-eight never cut at this age, and three but rarely. Similarly, forcible correction with anesthesia is favored by nineteen for extreme cases, by seven in most cases, while thirty-six are against the procedure. Up to the age of six months, then, the majority (56%) are opposed to operation or anesthesia, with most of the remainder (34%) conservative in their views, and but 10% who might be considered radical.

The same information was requested in the fourth question, which brought the age to two years and added the possibility of "bone or other extensive operations." At this age, or under, the majority (51) are conservative regarding tenotomy, performing it only in severe or complicated cases, while five will not cut at this age and ten tenotomize as a routine. For forcible correction, the same groups show thirty-five conservative, twelve against, and nineteen in favor. Bone or other extensive operations at this age are opposed in two-thirds of the replies, while the remaining third are conservative. None advise it as a routine. Comparing these figures with the preceding question, we find that the attitude of the majority (65%) toward tenotomy and forcible correction is here distinctly conservative, with 13% still opposed at this age and 22% favoring these methods. There is, therefore, a trend from the conservative to the operative treatment for the uncorrected club-foot in the second year of life, but it is also evident that the foot must present to the majority very urgent indications for cutting, and that more extensive operations than tenotomy are definitely opposed by most, and favored by none.

The fifth question was, "What is your general method in older or relapsed cases? What operative procedure do you find most successful?" The replies to this show that thirty-four generally employ radical bone operations, while twenty-one follow lesser measures by a bone operation only if the former fail, and twenty-four do not perform radical operations, eight of these still employing strictly non-operative methods. Several of the men recommend more than one method, depending on the age or type. Of the operations employed, forty-one perform cuneiform tarsectomy or osteotomy of the tarsus, nine prefer the Ober operation, three the Phelps, three Hoke's, and seven miscellaneous or original operations, a few using more than one. Operations more extensive than tenotomy, therefore, find favor in the treatment of the oldest or most difficult cases, although the majority do not prefer this method, and 30% never employ it.

In replying to the question as to what form of apparatus was used for correction, the majority (37) used none, and twenty-three used plaster of Paris as a corrective appliance. There were but five who used any kind of brace, which very clearly shows that the use of splints for correction has been generally abandoned. On the other hand, for retention, twenty-nine do not use braces in most cases (28 of these using plaster), while forty-three employ various forms, the T-strap shoe brace and Taylor brace being in the majority. Ten use their own types, four employ shoes only and four spoke of night splints. The majority, therefore, use braces for retention but not for correction.

If we may consider the foregoing at least suggestive of present tendencies in the treatment of congenital equinovarus, especially where there exists a definite consensus of opinion, there must be, then, some well defined reason for such uniformity. Practically no question, for example, arises as to the value of the earliest possible treatment, and very little as to the method of its application. The fundamental principles of the prevention of deformity must guide us here, as elsewhere, in the earliest prophylactic measures. True, there is here a deformity already existing, not one to be forestalled, yet at birth we have none of the secondary changes which must accumulate with every day of extra-uterine life. From the standpoint of prevention, then, it is expedient to lighten future labors by immediate measures. For the same reason, correction of the deformity permits of no postponement. The soft, elastic tissues of the infant's foot are most favorable for correction, and its factors are advantageous in inverse ratio to their duration. Early reshapement can be readily affected, and advantage taken

cf the rapid growth of the foot during the first year. If the foot grows straight, it will stay straight.

Arguments against the earliest treatment are necessarily few, yet they are heard. The most valid objection is based on contra-indication from the poor general condition of the child, due to illness, nutrition, or congenital handicaps. This is a legitimate argument, but it should not operate for any extended period, except in the most unusual instances. It is hard to conceive of a condition so detrimental that something, such as daily manipulation, cannot be carried out, and it is in few cases that the proper gradual non-operative treatment by successive manipulation and fixation cannot be performed with little or no effect on the health. Certainly if the child gives evidence of continued disability, it is not reasonable to postpone early treatment of a mild character for later treatment which must be far more drastic. It is held by some, too, that the infant's foot is too small and fat to enable proper grasp with the fixation appliances, notably plaster, and that a larger, better developed foot may be more easily wrenched into position. Such an objection is invalid in view of the relatively simple technique of early redressment, once mastered. The objection that an early corrected foot is difficult to hold corrected till the walking age, and should therefore be postponed until that time, merits much the same reply. A foot properly over-corrected at the age of three months can be kept over-corrected, with a constant increase of normal development and growth, by the simple expedient of alternating periods of fixation and freedom, which, combined with external elastic traction and massage, will almost always preserve the desired correction through the first year. If we keep the foot growing straight, it will be ready to functionate straight at the normal walking age, with the inestimable advantage of earlier corrective weight-bearing. This is just as important at this stage as early correction at the age without weight-bearing, thus eliminating all such deforming tendencies.

As to the method of application of this earliest treatment, there is again almost complete unanimity. Certainly manipulation must be thorough and frequent, for this is our real corrective agency. Yet to rely on manipulation alone is often a fallacy. Only the mildest foot, perfectly controlled, will respond to the point of continued over-correction without some retention. In the vast majority, and this must include the dispensary cases, alternate manual correction and fixation must be employed. For the latter, plaster of Paris stands preëminent, both as a corrective and a retentive appliance. The old style corrective braces were too selective in their application of force,

too cumbersome and complicated. The later, simpler models, mostly used for the early correction of varus, seldom achieve complete over-correction. Adhesive plaster has its merits in mild or early cases, or as an intermediary between plasters, but its universal application is disappointing. Plaster, properly employed, grasps all the structures of the foot, or any particularly resistant portions, as desired, maintains the maximum position gained, and is proof against subsequent slipping or interference. It should not cause atrophy and retarded growth, as sometimes claimed, if the proper technique is carried out. Immediate treatment obviates long incasement in plaster—early stimulating measures will overcome such slight untoward results as may arise from this treatment.

Coming now to the question of more radical measures in club-foot cases first seen at a later period after birth, it must be first observed that two groups of cases have been generally recognized, those seen very early, for which non-operative measures are proper and sufficient, and those seen at an older age, for which either operative or non-operative procedures, or both, may be used. Between these methods, individual choice varies, and controversy has arisen both as to the circumstances determining this choice and whether there is justification for more than one method. If we should use none but the most conservative measures in an infantile club-foot, should we employ more radical measures in an older foot, and if so, when?

A reply to this inquiry has been suggested in the answers to the third question. For the untreated case at six months or younger, more than half oppose any cutting or corrective measures sufficiently radical to require anesthesia, while most of the remainder would employ such methods only when they have failed with the conservative treatment. Evidently, the evils of traumatism cannot be overlooked by the surgeon whose object is ultimate restoration of the foot to normal function. The deformity of equinovarus is entered into in various degrees by practically all the structures of the foot, even in the earliest foot. No one tissue or part is at fault, and treatment must be directed to the whole foot, not localized as it must necessarily be by operation. Even a measure so simple as tenotomy cannot but weaken the muscle, while rapid forcible correction depends for its success on a tearing of the least resistant structures with definite functional impairment, and little or no corrective effect on many other elements of the deformity. Not only for these reasons, but also because of ease in application and the assurance of good results, non-traumatic methods are generally conceded to be indicated for the earlier club-feet. One exception only

can be made to this. Where absolute control of the case is impossible, due to inability of the parents to return frequently enough for proper non-operative care, as when living at a great distance, or when intelligence or coöperation might be questioned, milder radical measures may be necessary.

The main controversy, then, seems to lie between the application of operative and non-operative procedures in somewhat older cases. Here we are confronted with an established deformity, involving bones, joints, ligaments, and muscles. What is more natural than the tendency to overcome these difficulties by direct attack on the individual hindrances to correction, or at least on the more obstructive ones? Cut a few tight muscles, release a shortened ligament here and there, remove a bone block, if necessary, and force the foot straight. Surely this is not difficult, and if sufficiently complete, quite a normal appearing foot may result. But is a cosmetic result the end in view? If external form determined function, our result might be quite happy: but unfortunately function presupposes structural integrity. Should we, moreover, overlook the biological principle that it is function that has determined form?

If the establishment of normal action is, then, of prime importance in our conduct of these cases, where is the rationale of destructive measures in treatment? To what good purpose is the production of tissue matted by scar, binding and inactivating tendons important in locomotion, impairment of muscular action and balance by repeated tenotomies, interference with growth and development by injury to nerves and vessels, stiffening and shortening an already stiff, short foot by extensive removal of bone, further weakening of a weak member by the rupture of valuable ligaments?

It would seem, rather, that such complications should be avoided, that each step in the mechanical correction of the deformity should be taken with the definite object of restoring the usefulness of the foot, and that the slower manipulative method, which gradually reshapes the soft parts and bones without danger to the patient, without damage to any of the structures or interference with the circulation or growth, without loss of muscle tone or innervation, would more surely favor ultimate restoration of normal function along with normal form. During all of childhood, the tissue and bones are plastic, advantage may be taken of growth, and walking may be made an active agency in correction. To one who has observed the results of careful and persistent non-operative measures in older cases, the question would rather arise as to what age limit could be imposed on the

effectiveness of this treatment. Particularly is this true in the older or relapsed cases, in which, because so much trauma has already occurred, it is fair to consider the difficulty of correction often greater than in untreated cases of the same age. Here, certainly, the indication is to preserve and foster all the structures which have not been hopelessly damaged, by constructive rather than by destructive measures. The results in such cases, as well as the effectiveness of conservative measures in other types, together with the details of treatment, are omitted from this discussion, as they have been previously reported.*

It is not unfair to assume that the above principles have influenced the answers to the fourth and fifth questions. Despite the fact that more men favor operation in cases up to two years of age than in cases under six months, this increase is slight (20%) in view of the very great difference in the difficulties presented by the cases at these ages, and the majority still cling to non-operative measures as long as they can make them effective. As to more extensive operations than stretching and tenotomy, the majority are not only distinctly opposed to this treatment in cases up to two years, but are also definitely conservative toward destructive measures at any age. The best indication for extensive operative methods would seem to be a failure of conservative treatment, and this can be largely avoided by a better mastery of the manipulative technique for all ages. Only on such a basis of expediency as previously noted for tenotomy in the infant can we condone radical cutting of the foot. Undoubtedly the element of time may be a factor in the older cases, especially the adults, although the proper retentive stage after operating is often quite as long as that of the entire non-operative treatment. Certainly in the growing foot, it takes as long to develop all the structures into new shapes and positions after a few have been cut, as it does to reshape the entire foot by a procedure which from the first is designed to do just that thing. Only when growth has stopped, may we question the efficacy of gradual correction upon resistant bones and joints.

The reply to the sixth question indicates the almost universal use of the brace for retention of the foot after full over-correction has been obtained. In this stage, as in the previous, our whole object should be the restoration of normal action and strength, for this will prevent relapse as no other measures can. With the omission of plasters, ac-

* "The Prognosis of Congenital Club Foot and Its Relation to Non-Operative Treatment." Jour. A. M. A., July 31, 1915, Vol. lxv, pp. 375-380; "The Conservative Treatment of Congenital Club-Foot." Am. Jour. of Orth. Surg., December, 1916, Vol. xiv, pp. 693-707

tive physiotherapeutic measures can be begun in a systematic manner, especially applied to the muscles previously weakened and over-stretched. All apparatus at this stage should be the lightest and least constricting possible, and conform to the natural requirements of walking, with the weight thrown into the position of continuous over-correction.

Obviously, the important factors in the treatment of club-foot are the proper selection of treatment and the persistency with which this treatment is carried out, and to each of these equal weight must be given. Conscientious individual effort must always be rewarded, though much facilitated by an efficient technique. For the latter, two requisites would seem essential. First, as strict an adherence as possible to the principles of non-traumatism at all stages, regardless of any apparent indication for more drastic interference. If we are correct in assuming that damage to any structure tends to impair its usefulness, then the application of this theory must be carried out in every detail. Second, a thorough understanding of the measures available for conservative treatment during correction, overcorrection, and retention, these being manipulation to the point of tolerance, plaster or other mechanical fixation, corrective weight-bearing, massage and exercises. Advantage must be taken of all favorable factors present in the foot, with special reliance upon growth and the stimulation of such muscular forces as will favor overcorrection as the reshapement proceeds. The aim of treatment must be to reactivate the originally over-stretched muscles and ligaments, until they outbalance their previously contracted opponents. By this means, the active factors in relapse, namely the failure to obtain perfect over-correction, and to maintain it, will be rendered permanently ineffective. This is the essence of the conservative, functional treatment.

There is little that is inherently difficult in the treatment of equino-varus, but many misapprehensions may allow it to become difficult. The pathologic anatomy of club-foot is interesting and important, yet its intricacies are unnecessarily complex if we realize that it does not matter what is contracted or deformed, so long as the deformity as a whole is so attacked that all its intrinsic parts are simultaneously and equally corrected, and kept so. Consistent preservation of the natural endowments of the foot and avoidance of injury will compel its normal restoration by growth, accompanied by increasing activation in all its parts. It is in the direction of this more rational theory of treatment that our present day conduct of congenital club-foot appears to be tending.

DISCUSSION OF DR. FISKE'S PAPER.

DR. OSGOOD: The discussion on this paper, which is a very judicial and temporate review of the subject, will be opened by Dr. Albert Freiberg of Cincinnati.

DR. FREIBERG, Cincinnati: *Mr. President, and Gentlemen,*—Dr. Fiske's résumé of the treatment of congenital club-foot is so complete and so much in accord with my own ideas on this subject that I shall not say much. The desiderata which we must seek have not been quite stated by Dr. Fiske as I should state them. We must demand that the individual shall be able to dorsally flex his foot well beyond a right angle, and that he shall be able to pronate it with his own muscles. It seems, furthermore, that nothing will reshape the foot so much as function in the overcorrected position. How much can be done by merely manipulating and stretching the foot, without operations upon the bones, is not generally understood. We may use mechanical aids for this purpose, if we know how to use them. The matter of age does not frighten me because I have successfully corrected the severest kind of club-foot in a man of twenty-nine years who threatened to end his existence because his life had become a misery to him. He is now earning his living as a tailor, with his feet in dorsal correction, and can pronate with his own muscles. It would have been a great error to take out the astragalus in this man and leave a crippled foot, as I have seen done. The art lies in thorough manipulation of the foot and completely stretching the soft parts until they have lost their elasticity. This pertains to the feet which have not been butchered up by someone else, without result. With this class of feet, we have different problems. We have cicatricial bands, the results of trauma, in which cases I admit the aptness of such operations as Dr. Ober's. I shall have to admit the correctness of operations on the bones for some of these cases, but they will be few indeed. In my experience, the procedure has consisted of manipulation of the foot until it is in an overcorrected position and retaining it with plaster dressings in which the patient walks. Until he can dorsally flex his foot and pronate it with his own muscles, this must be continued, no matter how long it takes. When this can be done, we may speak of a cure, although corrective manipulations should be made daily for a long time after corrective dressings have been discontinued.

DR. FRANK OBER, Boston, Mass.: The causes of relapse is the thing which troubles most of us and it may occur after a considerable interval in a patient who has had a satisfactory overcorrection.

We will all agree with what Dr. Freiberg has just said, "A club-foot is cured when the patient can voluntarily overcorrect his foot in the pronated position." To my mind the chief obstacle to overcorrection is an inverted os calcis, and as this bone is held inverted by the thick, strong, internal lateral ligament the difficulties of pronating it are very great, especially in older children.

It seems to me that most of us are too easily satisfied with our results and therefore treatment is discontinued too soon and braces which do not overcorrect are applied too early.

Overcorrection should be maintained while the child is asleep, and after the retentive apparatus is removed the foot should be manipulated manually several times a day, at the same time teaching the patient to use the stretched peroneal muscles so that the position of valgus may be maintained voluntarily.

SIR ROBERT JONES: I am in absolute accord with Dr. Freiberg. We should recognize the causes of failure. The first is inefficient reduction, the second overlengthened tendons, and third the wrong alignment of body weight applied to the foot. Recurrences usually mean ineffectively treated club-feet, not always, but generally.

No matter how mobile a foot is in the surgeon's hand, unless the child has complete voluntary power to overcorrect its deformity, the foot is not cured.

One of the defects in manipulated club-feet is that knock-knee has been produced. This is due to bad technique—the epiphysis of the ankle and the internal lateral ligament of the knee should be prevented from being strained each time the foot is manipulated.

From early moments the twist of the tibia and fibula which so often accompanies club-foot, should be attended to by appropriate manipulation. Unless this be done the result when the child walks is appalling. We should overcorrect the deformity, see that the child can voluntarily overcorrect it, and walking should be permitted in flat-heeled boots without any apparatus. Let us hope that the days are passed when the so-called cure of club-foot involves the use of cumbersome and hideous harness.

Dr. Fred J. Gaenslen, Milwaukee: I hesitate to take up your time after this presentation and discussion, but wish that Dr. Fiske could have dwelt in greater detail on his technique. It consists essentially in gradual manual correction of the deformity, each successive step in the correction being maintained by means of a light plaster cast applied over a single layer of flannel glued to the skin. When the plaster is applied over thick layers of sheet wadded much of the correction obtained is lost and not infrequently the casts are kicked off or the foot is partially withdrawn from the cast with resulting distortion of the foot. The method is also useful in correction of foot deformity preparatory to tendon transplantation.

END-RESULTS IN THE OPERATIVE PROCEDURES FOR INFANTILE PARALYSIS, WITH SPECIAL REFERENCE TO TENDON TRANSPLANTATION AT THE WIDENER TRAINING SCHOOL FOR CRIPPLED CHILDREN.

A. BRUCE GILL, M.D., PHILADELPHIA.

Children are admitted to the Widener Memorial Industrial Training School for Crippled Children between the ages of four and ten years, and are discharged when eighteen to twenty years of age. They are therefore resident in the School for periods of between eight and sixteen years, with the exception of those who are discharged for one reason or another before they have completed their academic and industrial training. The population is limited to one hundred. While these circumstances greatly limit the number of crippled children who can receive the benefits of the School, they render possible a long continued observation and training under absolute control and permit of such complete orthopædic care as is possible in but few other institutions of this country and not at all in our hospital or private practice. Unusual opportunity has thus been afforded for accurate

observation of the results of various operative procedures in the treatment of infantile paralysis during the fifteen years since the School was opened. No children are discharged or graduated if it is evident that anything more can be done to improve the function of their crippled members. Many have been operated upon four, five, and six times.

It has been the writer's privilege to maintain continuous service in the School for the past fourteen years as Resident Physician, Assistant Surgeon, and finally Chief Surgeon.

The end-results of the operations performed upon one hundred and sixteen children are tabulated in the following pages, evident conclusions are drawn, and the measures which experience has proved valuable and which are now employed in the correction of the various deformities and disabilities of infantile paralysis are recited.

This series of fifty-nine operations of tendon transplantation in the lower extremity includes only those in which the transplantation was done primarily and uncombined with any other type of operation, such as subastragalar arthrodesis, or horizontal transverse section, or tendon fixation.

The operations marked successful required no subsequent procedure to correct deformity or improve function and the children were enabled to walk without the use of apparatus, except where a greater disability higher up forbade.

Some of the improved cases presented so slight residual deformity that further operation was not justifiable, while others required secondary operation. In the latter class it was evident that the tendon transplantation was of value in the final correction. This was particularly apparent at the knee. The muscle transplanted to take the function of a paralyzed quadriceps was unable to extend the leg against gravity, but greatly aided in stabilizing the knee after an osteotomy of the femur had been done to make a back knee. In all of these cases the patient was enabled eventually to walk without apparatus.

In the six instances in which an original pes valgus was transformed into a pes varus there was a period of from one to four years following the operation during which the foot presented no deformity. On the first appearance of the varus the feet were manipulated under an anesthetic and put up in a plaster in a position of valgus. But always the varus recurred. Retransplantation of some of the tendons, combined with subastragalar arthrodesis, and even wedge resection of the tarsus was required to secure permanent correction.

In the unsuccessful cases there was complete failure to correct deformity or improve function. A few of them showed some improvement for a time, but relapse followed, while in others the muscles continued to show some power, but insufficient to influence the member. For example, an apparently normal extensor proprius hallucis transplanted to take the place of a paralyzed tibialis anticus is usually unable to overcome the established deformity or to prevent its recurrence if corrected; eventually it becomes overstretched and acts but feebly or not at all.

Therefore, the results of tendon transplantation for deformity of the foot when uncombined with any other type of operation would appear to be uncertain. In this series, 22% were successful, 11% improved, and 67% failures. The same muscles transplanted in the same manner and by the same technique sometimes produced correction, sometimes overcorrection, and sometimes no effect at all.

The lateral muscle balance of the foot seems to be delicate, and once disturbed by paralysis, is not easily restored by surgical intervention. Unless balance is fairly even the foot will in time incline to one side or the other; and when inclination once appears its progress to marked deformity is fairly rapid.

If lateral motion of the foot, which occurs chiefly in the subastragalar joint, *i. e.*, the articulation of the astragalus with the scaphoid and the os calcis, were necessary to standing and walking, we should be justified in continued attempts to preserve it. But cripples who have had an arthrodesis of the subastragalar joint have quite good function of the foot, which is able in walking even to accommodate itself to inequalities of the ground through the joints anterior to the astragalo-scaphoid articulation. Since, therefore, it is difficult to secure balanced lateral motion, and since it is not an absolute essential, is it not wise to correct lateral deformity by the abolition of lateral motion and to employ whatever power is present in improving antero-posterior function? Must we not recognize that a foot which has been permanently crippled by infantile paralysis can never, by any manner of means, be restored to its original condition? Something is gone forever. In some cases, it is true, motion may be preserved or restored in all directions fairly effectively. In others the balance of power has been so seriously disturbed, or the residuum is so slight, that it is futile to attempt to preserve all motions with good function. In such cases it seems best to eliminate the motion which is the least essential and use all muscles for the more useful one.

If, however, lateral motion is eliminated by a sub-astragalar arthrodesis and there remains an unbalanced lateral muscle tension, the arthrodesis will remain solid, but lateral play and deformity will appear in the ankle joint. Indeed, it is at times observed in cases of marked pes valgus, whether the foot be flail, or whether power be present, that while the greater portion of the deformity is in the subastragalar joint, a part of it is in the ankle. This can be easily demonstrated by grasping the astragalus and moving it from side to side, or by correcting the subastragalar deformity manually or by operation and then observing how the foot which is straight passes into valgus on dorsiflexion.

Therefore, to perform a subastragalar arthrodesis alone when there is marked lateral muscle unbalance is not sufficient. While we utilize all power in the foot for plantar and dorsal flexion, we must so distribute it that a fairly even pull is made on both sides of the foot or centrally over it. The peroneus tertius, together with the extensor communis digitorum, will not only dorsiflex the foot, but will pull it into valgus unless balanced by power that will elevate the foot on the inner side or unless these tendons are made to act centrally over the dorsum of the foot. The extensor proprius hallucis, or a peroneus tertius may be used to supply power to the inner side of the foot. The Whitman loop operation not only transfers power to the inner side through the transplanted peroneus but also centralizes the dorsal pull of the extensors of the toes. However, in my opinion, this operation, for several reasons, should always be combined with a subastragalar arthrodesis. I have so employed it with splendid results as far as can be judged at this comparatively early date.

In combined lateral and antero-posterior deformity the lateral motion should be abolished, and attempt made to secure muscle balance in plantar- and dorsiflexion.

In equino-varus, in which there is paralysis of the tibialis anticus, the common extensor, and the peronei, and power in the triceps, or tendo-Achillis, and the tibialis posticus and possibly the extensor proprius hallucis, a subastragalar arthrodesis, and fixation of the common extensor into the tibia, may produce a fair result. Various other combinations may be employed as well. But when a strong triceps has nothing to balance it in front there is no operation which fully and uniformly solves the problem. Anterior tendon fixation can scarcely be expected to hold against the strong and constant pull of the tendo-Achillis, and arthrodesis of the ankle destroys its function. A com-

plete and solid tendon fixation, if such be possible, does practically the same thing.

Equinovalgus with power only in the peronei and the triceps, while rare, presents much the same difficulty. But one peroneus may be transferred forward of the external malleolus without detachment from its insertion, so that it may act as a dorsiflexor. And the other peroneus may be transplanted to the inner side of the foot. In one case in this series the peronei were both transferred forward of the malleolus without very good result. Subastragalar arthrodesis is to be combined with this operation.

Pes calcaneus should be corrected by a horizontal transverse section or an astragalectomy. While we employ the former we by no means belittle the latter. In addition, the tendo-Achillis may be fixed into the fibula. One such fixation was done with perfect result. If valgus is also present, due to power in the peronei, these tendons should be transplanted to the os calcis. Anterior power should be balanced so far as possible.

If the foot is flail, the so-called dangle-foot, a horizontal section or astragalectomy will stabilize it. But if the entire extremity is flail, a combined subastragalar and ankle arthrodesis will stabilize the knee as well as the foot.

SUBASTRAGALAR ARTHRODESIS.

Successful, requiring no subsequent operation to correct lateral deformity, or to stabilize the foot.		
In flail feet	31	
Combined with tendon transplantation	6	
Following unsuccessful primary tendon transplantation	6	
Combined with Whitman loop operation	1	
	—	44
Unsuccessful, requiring subsequent operation for lateral deformity		
In flail feet, due to putting foot in plaster in faulty position after operation	4	
Developing subsequent to operation and due to unbalanced muscles	5	
Due to lateral deformity in ankle	7	
	—	16
		—
TOTAL		60

The sixteen cases in which lateral deformity was not altogether cured by the primary arthrodesis were subsequently corrected. If the deformity is at the site of the arthrodesis, the surgeon can readily by means of a gouge make a section through the foot beneath the astragalus in the same plane as that of the primary operation, loosen the foot from the astragalus, and fix it in plaster in the desired po-

sition. No elements of the foot have been destroyed or removed by the arthrodesis. The ankylosis can be broken up at any time and the foot placed in correct position. This is a great advantage of the operation. "If at first you don't succeed, try, try again!" In this series a second section was done eight times, and a third section once. In three cases tendons were transplanted subsequently to balance muscle pull. In thirteen patients subastragalar arthrodesis and ankle arthrodesis were done simultaneously, or at different times.

Never was there a failure to secure ankylosis.

An inversion and adduction of the anterior part of the foot is at times observed in cases in which the posterior part of the foot has been cured of its pronation. This is probably the persistence of the rotation of the antitarsus which is an element in a pronated foot. It can usually be corrected by vigorous manual manipulation; or, if not, by a vertical section through the foot in front of the astragalus.

HORIZONTAL TRANSVERSE SECTION.

Successful, requiring no subsequent operation		
In flail feet	11	
Combined with transplantation of peronei to os calcis	8	
Subsequent to tendon transplantation	2	
Combined with fixation of tendo-Achillis to the fibula	1	
	—	22
Unsuccessful, requiring subsequent operation		
Second section to displace foot backward	4	
Second section for lateral deformity	1	
Ankle arthrodesis for lateral deformity	1	
Ankle arthrodesis to correct calcaneus	2	
Ankle arthrodesis and osteotomy of femur to stabilize the knee	4	
	—	12
		—
TOTAL		34

HORIZONTAL TRANSVERSE SECTION.

Horizontal transverse section of the foot, like subastragalar arthrodesis, can be repeated if the primary result is unsatisfactory. The early operations were little more than an arthrodesis because the foot was not displaced far enough backward to eliminate completely the calcaneus deformity. Those done in recent years with improved technique have proved almost uniformly satisfactory.

The best function is obtained in those feet in which good peronei are transplanted to the os calcis when the horizontal section is done.

In the earlier years at the School arthrodesis of the ankle was performed for pes calcaneus, but was discontinued when it was learned that other operations give better results.

OPERATIONS AT THE KNEE.

The problem of stabilizing the knee so that the patient can bear weight without apparatus varies with the condition of paralysis present in the extremity. If there is strength in the gluteal muscles the patient may walk well though he have no power below the hip joint. He can go up and down stairs even with moderate contracture of the knee. But he walks better if the knee hyperextends at each step. The contracture may be manually corrected under an anesthetic but will frequently recur; so that after numerous attempts thus to secure a permanent back-knee, the surgeon is forced to do an osteotomy of the femur above the knee and bend it backward. The osteotomy is usually required primarily in patients over twelve years of age who have had a long continued contracture.

Knock-knee is frequently present and should invariably be corrected, even though quite moderate. A combination of genu-valgum and flexion contracture constitutes an exceedingly weak position, and their correction alone will enable many a patient to walk.

The ilio-tibial band is frequently shortened and is a strong, possibly the chief, deforming element. The external intermuscular septum participates in the contracture. Both must be divided by the scalpel.

If the entire extremity including the gluteal muscles is flail, the problem is difficult. It may be met by ankylosing the ankle with the foot at an angle of one hundred to one hundred and five degrees with the leg, and by hyperextending the knee. When the body weight then falls upon the ball of the foot it forces the heel to the ground and drives the knee backward because the ankle is rigid. Thus the weight of the body is made to sustain itself.

ARTHRODESIS OF THE ANKLE AND OSTEOTOMY OF THE FEMUR.

Arthrodesis of the ankle has been performed forty-nine times to stabilize a flail extremity; seventeen times alone, and thirty-two times in combination with an osteotomy of the femur. In all cases before operation the patient walked with a lock-joint brace or by holding his knee back with his hand. Thirteen of the seventeen and twenty-one of the thirty-two, a total of thirty-four out of forty-nine, subsequently walked without apparatus or without holding the knee or touching the thigh with the hand.

The children who were obliged to continue the use of lock braces were for the most part those with complete paralysis of both lower extremities, weakness of the muscles of the back, and in some instances subluxating hips.

OSTEOTOMY OF THE FEMUR.

Total operations	57
Braces no longer required	38
Braces required	19
Osteotomy repeated once in same femur	10
Osteotomy repeated twice in same femur	1

Almost all these cases were first forcibly extended, but either deformity recurred or knock-knee was present.

TENDON TRANSPLANTATION AT KNEE.

In the less severe cases that present quadriceps paralysis with power in other muscles of the thigh, it is well worth while to transplant a suitable muscle to substitute for the quadriceps, provided always that hyperextension of the knee is secured and knock-knee corrected.

A good sartorius will give a splendid result. In this series of cases it failed once out of five times, only because it had very slight power.

The biceps and the semi-membranosus, if properly transplanted, also are useful. The author prefers to use the biceps because it can be made to pull in a more direct line than can the internal hamstring.

Nor is the tensor fasciae femoris to be scoffed at. In this series it was transplanted once by Lange himself by his silk-tendon method, and three times by the Kofmann operation. The latter gives the better result. A strip of the fascia lata a half inch in width from the insertion of the tensor fasciae femoris down to the knee joint is moved inward like a tendon and sutured to the patella. Its assistance, though moderate, may be sufficient to stabilize the knee. In all three cases, it exerted an active voluntary pull on the patella and was almost strong enough to maintain the knee in extension against gravity.

ROTATION OF THE LOWER EXTREMITY.

Some patients walk with one or both of the lower extremities in marked internal or external rotation. Dr. G. G. Davis's method of fixation of the fascia lata to the great trochanter of the femur was done seven times, in six of which it was completely effective in maintaining the extremity in a straight, or neutral, position.

STABILIZATION OF THE HIP.

The class of cases mentioned as failing to secure stability through ankle arthrodesis and osteotomy of the femur present one of our most difficult surgical problems. Many of them must probably be satisfied to get about with lock-joint braces, with or without a pelvic band, and with crutches.

I have done an arthrodesis of the hip-joint in two patients. The hips were completely flail and frequently were dislocated in walking and caused the child to fall. The results in both instances have been very favorable. The arthrodesis has been solid and painless, and the patients have much greater stability.

PARALYTIC SCOLIOSIS.

Bone transplantation has been performed seven times, the first operation being done five years ago. The results are encouraging. The children have been enabled to sit erect without supporting themselves by the hands. They are able to feed themselves, to dress, and to use their arms otherwise when sitting. These things they could not do before operation. The spines are held rigid and deformity has been prevented throughout the extent of the graft.

Where marked curvature exists the spine is first straightened in whole or in part by lateral traction in recumbency.

The technique employed is a combination of the Hibbs and the Albee methods of fixation. Complete dissection, denudation, and digging up of the spine are done after the Hibbs' method on the concave side. A bone transplant is then placed in contact with the laminae and the spinous processes are drawn and held in firm contact with it by strong sutures. This straightens the spine, and gives a firm permanent fixation.

Radical operation has been forced upon us after long observation of the terrible deformities which developed in spite of our best conservative methods of treatment.

FLAIL SHOULDER.

Silk ligaments were twice inserted through the acromion and the head of the humerus before we satisfied ourselves how foolish we were to expect such device to maintain the humerus in abduction to the

scapula. And for a long time the condition of flail shoulder seemed one of the insuperable handicaps to the cripple. But since we have learned how to do an arthrodesis of the shoulder we no longer dread to see this extremely disabling condition.

The value of the operation consists not only in the stability it gives the patient to raise his arm from his side, but in the much greater advantage of the complete control of the extremity and the ability to put the weight of his entire body behind his hand in pushing, pulling, lifting, and striking.

Heretofore we have been slow to admit to the Widener School children seriously paralyzed in the arms because such condition prevents their learning a trade. The perfecting of the operation of arthrodesis of the shoulder will probably enable the School to accept children it has heretofore refused.

Thus arthrodesis of the hip, the spine, and the shoulder, are attacking vigorously the last awful strongholds of infantile paralysis.

TENDON TRANSPLANTATIONS IN THE FOREARM.

Well considered tendon transplantations in the forearm are uniformly successful, because the elements of gravity and weight-bearing, so important in the lower extremity, are absent. The principles and methods of operation which determine the utilization of the power which is present to the greatest advantage I shall not here discuss.

Arthrodesis of the first carpo-metacarpal articulation to maintain a flail thumb in opposition and transference of power to the flexor longus pollicis is a most useful procedure.

These measures have been repeatedly employed and have enabled children to learn a trade, such as watch and clock making, and earn a splendid livelihood which would otherwise have been impossible.

Arthrodesis of the wrist should be considered in those patients who possess but slight power so that it may be employed entirely in movements of the fingers and thumb.

TENDON FIXATION.

Our experience with tendon fixation has been limited. Foot-drop was permanently corrected five times and relapsed eight times. Lateral deformity was corrected thrice and recurred once.

While a flail foot may be kept from dropping by fixation of the anterior tendons we can scarcely expect to maintain correction against

the pull of a strong tendo-Achillis. That tendons will stretch has been demonstrated by exploratory operation after the recurrence of deformity.

So frequently the dropping of the foot is combined with other deformity or instability which can be more certainly and simply remedied by an arthrodesis or astragalectomy as previously mentioned.

Our judgment is that the application of tendon fixation is limited, and that deformity and instability are for the most part better corrected by other means.

SILK LIGAMENTS.

Silk ligaments held a flail foot from dropping twice and failed thrice. They corrected a lateral deformity twice. In two cases they were inserted to fix a flail shoulder, and utterly failed.

Their use has long since been discarded.

PRIMARY TENDON TRANSPLANTATIONS UNCOMBINED WITH OTHER TYPES OF OPERATIONS.

	Successful	Partially successful Improved	Overcorrection	Unsuccessful Complete failure	Total
Pes valgus	8	1	6	18	33
Pes calcaneus	2	4		6	12
Quadriceps paralysis	3	9		2	14
	13	14	6	28	59

Pes valgus Tendons transplanted to the inner side of the foot	1.4th & 5th E.C.D. (Peronei also to) (os calcis) 2.4th & 5th E.C.D. & peroneus brevis. 3.4th & 5th E.C.D. & both peronei. 4.Peroneus brevis. 5.Peroneus longus. 6.Both peronei. 7-8. E.P.H	1.4th & 5th E.C.D. & E.P.H.	1.4th & 5th E.C.D. & peroneus brevis (to tibialis posticus) 2.4th & 5th E.C.D. & E.P.H. 3-4-5.4th & 5th E.C.D. & both peronei 6.E.P.H. and both peronei.	1-6.4th & 5th E.C.D. 7-12.E.P.H. 13-15 Peroneus brevis 16.Peroneus longus. 17.Both peronei. 18.4th & 5th E.C.D & E.P.H.
Pes calcaneus Transplanted to the os calcis.	1-2.Both peronei.	1.Both peronei. 2.Peroneus brevis. 3.Peroneus brevis & tibialis anticus. 4.E.P.H. and tibialis posticus.		1-3.Peroneus brevis. 4.Both peronei. 5.Tibialis anticus. 6.E.P.H.
Quadriceps Paralysis Transplanted to the patella	1-2.Sartorius. 3.Semimembranosus.	1-2.Sartorius. 3-4 Semimembranosus. 5.Biceps. 6-9.Tensor fas.fem. **Kofmann's operation		1.Sartorius. 2.Semimembranosus.

E.P.H. = Extensor proprius hallucis.
E.C.D. = Extensor communis digitorum.
Tensor fas. fem. = Tensor fasciae femoris.

* The peroneus tertius, when present, was always transplanted with the extensor tendons of the fourth and fifth toes.

** Zeitschrift für Orth. Chir., Band 33, 1913.

SUITABLE TIME AND AGE FOR OPERATION.

As a general rule only the operations necessary to the relief of contractures are done within the first three or four years after the onset of paralysis. All constructive operations are delayed until the child is seven or eight years of age, when tendon transplantation may be combined with arthrodeses. We formerly transplanted tendons earlier, but learned in time the futility of such procedure.

We see no necessity or advantage in waiting until the patient is twelve years of age and upward. To the contrary, deformities and disabilities may be so confirmed by that time that correction is difficult.

Finally, it may be said that the last word has not yet been uttered as to the operative treatment of infantile paralysis, and it behooves us all to keep an open mind and not to become so wedded to our own opinions that we would not change them for better.

DISCUSSION OF DR. GILL'S PAPER.

Dr. John L. Porter, Chicago: In my experience with tendon transplantation, as done by others and myself, I have been impressed with the fact that has been brought out by Dr. Gill in his paper, that the failures were much greater than the successes. He called tendon transplantation a failure, when done alone, and unconnected with other operations. He has not attempted to explain why there is such a large proportion of failures; and I have asked myself why, in so many instances, it fails to accomplish what we hope it will accomplish. I have analyzed my own cases and studied many which I have seen, and it seems to me that the reasons may be considered under four or five headings:

First, an insufficient study of the mechanics of the deformity before the operation is performed. For instance, what doth it profit a joint to transfer all the muscles on one side to the other side, with nothing left to stabilize the joint on the side that you have sacrificed? Nothing. Yet we see it done frequently.

Second, the use of muscles that are inadequate to perform the duties that we require of them. Dr. Gill has spoken of that in speaking of the transplantation of the extensor proprius hallucis to the tarsus, to take the place of the anterior tibial. It is not strong enough to replace that muscle.

Third, the transplantation of the tendon before giving the weak muscles a chance to recuperate. I have learned, before transplanting any muscles or doing any operations on a case of infantile paralysis, to put the overstretched muscles, which have not functioned for months, in a state of relaxation, and give them a chance to contract, and hold them in that position for many months. I have been astonished to find, in cases where I expected to have to do an arthrodesis, that sufficient power would be developed, simply by giving them a rest in the relaxed conditon. Sir Robert Jones was the first who showed me the great importance of giving a weak, paralyzed, or supposedly paralyzed muscle a chance to recuperate.

Fourth, errors in technique, such as carrying the implanted tendons through tissues to which they must become adherent without the tendon sheath. So many times, the tendon sheath is stripped up to such a degree that adhesions cannot help forming, and in that way vitiate the result.

Fifth, more poor technique, in failing to attach the transplanting tendon firmly to the bone and periosteum. It is useless to transplant an active tendon to a paralyzed tendon, unless close to the insertion of the paralyzed tendon. The only way that I can get good results is to split up periosteum at the point where the tendon can functionate most satisfactorily, dig a little hole and bury the tendon in the bone, and then cover it with a flap of periosteum from each side. I have never yet seen a transplantation of the hamstring tendons to the sartorius, or to the patella, to take the place of the quadriceps, which was satisfactory and it seems to me that one of the important features that we overlooked in our early work, was failing to stabilize the joint in transplanting tendons. The tendon transplantation that has been most satisfactory to me has been the transplantation of the peroneus longus to the inside of the foot, to take the place of the anterior tibial or to help stabilize the joint, where both the perinei were active; and in transplanting the peroneus longus for that purpose the best success has been in dissecting up the tendon completely, with its sheath, clear up to its origin, splitting the intermuscular septum with blunt dissection, and carrying it down through the sheath of the tibialis posticus. Holding it in place a long time after the operation has given good success, because an active muscle is left on the outside, and putting the two on the tibial side makes a balance. It does work.

SOME POINTS ON IMMOBILIZATION TREATMENT OF SEPTIC KNEE JOINTS

BY FRANK R. OBER, M.D., BOSTON, MASS.

The object of this paper is to present to you, in a more or less detailed way, some points which seem to me to be very essential in the immobilization treatment of septic knee joints.

MATERIAL.

The material was obtained from nearly one hundred cases of septic knee joints treated at the base in France in 1917 and 1918. A very large number of them had very extensive wounds of the structures concerned in the normal function of the joint and some of them had severe wounds elsewhere which complicated the treatment of the joint condition.

There were no amputations for sepsis, one amputation for gas gangrene of the thigh, three amputations for destruction of the great vessels followed by gangrene, one death from secondary hemorrhage and no deaths from sepsis.

GENERAL CONSIDERATIONS.

Mobilization treatment is ideal because it aims to secure a joint with normal function, but it has its limitations, a few of which follow: treatment should begin at the earliest possible moment, and before the membrane becomes thickened: it is necessary to have a joint potentially capable of active function, which means there cannot be any great destruction of bone and muscles; nurses and orderlies must be trained to carry out the treatment, as prescribed, at regular intervals, because ignorance and neglect always spell defeat. Therefore, as it is not always possible to overcome all these limitations we must sometimes fall back upon the immobilization method which is as exacting on knowledge and good care as the mobilization method. Success will be obtained only by a studious attention to all the minor details of management of the leg, splint, dressings, and patient from the beginning to the end of treatment.

PATHOLOGY.

Primary Pathology of the joint condition. Early, there is a simple empyema which is essentially a synovitis acting as a culture medium for organisms. Later on, the synovial membrane becomes thickened with granulation tissue and the recesses of the joint are walled off by adhesions, sometimes resulting in fibrous ankylosis and finally there is a severe type in which the cartilage and ligaments are destroyed, the joint exeising itself, resulting in bony ankylosis.

Secondary Pathology means burrowing of the pus outside the joint structures. This is a complication and is encouraged by the shape of the bony structures forming the joint and the relation of the attached synovial membrane to these structures. It probably takes place in two ways, either by direct, mechanical rupture of the joint membrane or by erosion of the membrane and a spreading infection along the fascial planes. It is seen most frequently above the supra patellar pouch and may extend above the thigh as high as the great trochanter. It occurs beneath the fascia lata or the quadriceps muscle. Posteriorly it extends up the thigh, beneath the hamstrings, or follows the femoral artery through its opening in the adductor magnus and then up the thigh along Hunter's canal. Posteriorly, it may also extend down the leg beneath the popliteus and gastrocnemius or it may follow the anterior tibial vessels, burrowing down the anterior aspect of the leg between the muscles and the interosseous membrane.

SYMPTOMS.

Rise in temperature, rapid pulse, increased white blood count, distention of the joint, thickening of the membrane, tenderness in the popliteal space, edema about the tibial tubercle, pain about the joint and muscle spasm. Diagnosis is made on the presence of the above symptoms and signs and it ought never to be necessary to aspirate the joint for the purpose of finding the organism.

Symptoms of burrowing. Increase in temperature and pulse, and there is usually swelling over the pus area. There are many cases, however, in which burrowing takes place when no swelling is present and there may be no especial rise in temperature but the pulse remains high. In my experience, pain on deep pressure has always been diagnostic.

SURGICAL TREATMENT.

The surgical treatment of these cases of septic arthritis resolves itself into three distinct groups as follows:

1. Those cases which had been operated early, and later became septic.

2. Those cases which arrived twenty-four to forty-eight hours after being wounded and were unoperated.

3. Operative interference in which there was burrowing and abscess formation secondary to the joint infection.

In the first group, patients usually came directly from the casualty clearing station very soon after operation, and an examination nearly always showed the presence of a moderate reaction, as evidenced by tenderness, swelling, fluid in the joint, some thickening of the membrane and a moderate reaction of temperature and pulse. In a fair proportion of cases this could be attributed to the trauma of operation and transportation. These patients were carefully watched for a day or two and if no infection were present the above symptoms gradually subsided. If, however, these symptoms continued or increased, some of the sutures were removed, allowing the retained pus to escape.

Second Group. Cases unoperated: these cases were carefully x-rayed for the purpose of localizing foreign bodies and diagnosticating fractures. It often happened that this type of case would quiet down under immobilization and operation for the removal of the foreign

body was deferred for ten or twelve days after the temperature had dropped to normal, but if there were indications of beginning sepsis the wounds were excised, foreign bodies removed and devitalized bone thoroughly curetted until there was bleeding. A soft rubber catheter was then inserted and the joint gently irrigated for at least ten minutes by the clock, washing out all fibrin and blood.

The synovial membrane, aponeurosis and skin were sutured in layers, a small rubber tissue drain was inserted down to the capsule to take care of any joint oozing, at the same time draining subcutaneous tissue, in the fat of which infection occurs so easily. This method, which has been employed by Cotton, was successful in a fair percentage of cases and when it was not, it was very easy to treat the joint as in group one.

Group Three. The surgical treatment of burrowing is thorough, through and through drainage in the most dependent portions of the abscess as soon as the diagnosis is made.

DRAINAGE.

It is the opinion of most surgeons having experience in treating joint sepsis that drains in contact with the synovial membrane of a freshly opened joint are not well tolerated. If one observes joint surfaces with which a drain has been in contact, it will be noted that there is an area of hyperemia about the drain and that this area bleeds easily. The frequent removal and renewal of drains, no matter how carefully done, always dilates and tears bleeding tissues, thus opening up new avenues for absorption. On the other hand, when the joint surfaces have become walled off by granulation tissue, they are well tolerated but should not be removed oftener than once in six or seven days.

The type of drains found to be most serviceable was the so-called cigarette drain, and two in the same opening gave better drainage than one. When the infection subsided they were replaced by strips of rubber tissue.

METHOD OF SPLINTING.

There are five prominent factors concerned in continuing and increasing the septic condition of the patient, which are more or less dependent upon the method of splinting and the rigid care employed in immobilization, and are as follows:

1. Pain.
2. Passive manipulation.

3. Irrigation at the time of the dressing.
4. Frequent changing of dressings.
5. Frequent operations performed with the idea of reducing temperature.

Having learned in early orthopaedic experience that a flexed arthritic knee was more comfortable than an extended one, and that many patients dated their first night's rest from the institution of the flexed position, it seemed reasonable that septic joints might be more comfortable in a flexed position and, with few exceptions, the knees were placed on bent Thomas splints as follows:

A splint was secured with a well padded and snug-fitting ring, bent at the knee at an angle of about twenty degrees, placed very gently over the leg, pushing the ring snugly against the tuberosity of the ischium. The leg was supported temporarily by means of slings beneath the popliteal space and heel. Traction strips were next applied to the lower leg. When this had been done flannel strips as slings were applied from the ring to just above the heel, the heel strip being removed in order to avoid pressure. Next, the traction was secured to the end of the splint and the leg packed off on each side above and below the aseptic region with cotton; these areas were then snugly bandaged, such bandages being changed at rare intervals. The dressing in the region of the wound was covered by means of a triangle, as it was found that the application of a roller bandage consumed a good deal of time in the aggregate, and, when applied with the greatest amount of care the twisting motion was apt to rotate the splint and result in discomfort a few hours later. The splint was secured to a bed cradle or Balkan frame in such a way as to avoid twisting; the leg was never allowed to rest at any time on the bed, as that was found to be an uncomfortable position. Occasionally, a straight splint was used but we very soon learned that the knee sagged and became hyper-extended, necessitating frequent adjustments of the slings, both of which factors were pain producers. In very sensitive joints, especially in those complicated by fracture, it was usually necessary to obtain more traction than has been described. This was accomplished by raising the foot of the bed and fastening the lower end of the splint to a Balkan frame.

METHOD OF DRESSING.

When a dressing was done the three straps in the region of the knee were loosened and the dressings removed very gently, the wounds were swabbed with some antiseptic, the skin edges carefully cleaned

with ether and alcohol, and a protective dressing of sterile vaseline strips or rubber tissue was applied. A pad, ten by eighteen inches, was placed transversely beneath the leg and covered with loose gauze; the anterior wounds were dressed with gauze and the ends of the pads were gently pulled up between the uprights of the splint and the leg; then the slings were replaced carefully and snugly.

PASSIVE MANIPULATION.

It was soon discovered that any passive manipulation of the joint was always followed by a rise in temperature which lasted three or four days. Therefore everyone was careful in the bed nursing of the patient to avoid any manipulation of the splint or the patient which would result in joint motion.

IRRIGATIONS.

As a surgical principle it would appear that frequent flushing of joint wounds would clear away the debris, diminish absorption and hasten progress. On the contrary, irrigation of joint wounds, even in the late stages, was practically always followed by a general and local reaction, evidenced by a rise in temperature and pulse, onset of pain, and occasionally digestive disturbance in the bad cases. Therefore, postoperative irrigations were given up with only occasionally lapses, which were always followed by the above results. Carrel-Dakin was also given a careful trial but this method did not hasten progress nor prevent tracking of pus; it necessitated frequent changing of dressings, in itself a factor in prolonging the septic condition.

FREQUENT CHANGING OF DRESSINGS.

John Ardine, an English surgeon of the fourteenth century, said, "There is rule in which I have seen err in my time, almost all men not practical but fools; that is to say, of the frequent dressing of wounds. And when such idiots be openly known and not reproved they vex themselves and their patients by their ignorance." It was his custom occasionally to dress wounds daily, but usually he allowed an interval of three days to elapse before renewing his dressings.

When I learned to omit daily dressings I found that the patient's general condition improved more rapidly than in those cases in which daily dressings were done and the temperature and pulse reached a lower level much sooner.

FREQUENT OPERATIONS PERFORMED WITH THE IDEA OF REDUCING TEMPERATURE.

There is no place in surgery where one becomes so concerned as in the presence of a rise in temperature and pulse from a septic knee-joint. Under such conditions radical operations are often performed —such as a U-flapped incision or amputation. It is well to remember, however, before rushing patients to the operating room, that the synovial membrane is one of the most resistive tissues to infection of any in the body and if given half a chance will usually take care of itself.

There is so much ramification of the joint structures, however, which favors the development of focal walled-off abscesses in the several pouches that one must be prepared to secure drainage when necessary. This should be done without removing the patient from the bed or the leg from the splint. A Kelley clamp should be placed in the distended pouch and cut down upon and before removing the clamp a small rubber tissue drain may be drawn through the opening. Frequent operations mean frequent anæsthetizations, which always lower the resistance of the patient; therefore the period of anæsthesia should be as brief as possible and not oftener than absolutely necessary.

SUMMARY.

1. Mobilization will not always replace immobilization, as there are many cases in which mobilization is contraindicated.
2. Careful attention to minor details in adjustment of the splint and bed nursing increases the patient's comfort and resistance.
3. A bent Thomas splint is more comfortable than a straight one and is more easily managed.
4. Slackness and carelessness will always be followed by disaster.
5. Surgical interference should be gentle and precise.
6. Passive manipulation, irrigation at the time of dressing, and frequent changing of dressings all tend to prolong the septic condition.

Reference.

[1] British Surgical Journal, April, 1918.

DISCUSSION OF DR. OBER'S PAPER.

Dr. W. G. Turner, Montreal: *Mr. President and Gentlemen:*—In many of the out of the way places we wander to, we see certain shrines and I think that a shrine should be set up regarding the Thomas splint. Apparatus have been devised, but the only one that has stood the test has been the Thomas

splint. I have been much interested in Dr. Ober's paper on septic knee joint because at one time we were face to face with the task of trying various treatments. It appears to me that the question of the origin of septic knee joint comes under the different headings of penetrating wounds, with or without missile, and septic knee joint of metastatic origin. These can be taken up under two distinct headings regarding treatment. In the service, the treatment that was rapidly evolved, I may say, came under the consideration of various consultants, and the prophylaxis which was secured there was certainly due to our very distinguished friend, who is here today. In 1915, the transportation of these septic knee cases was hurried through to the base, and very often the primary so-called thorough treatment occurred at the bases in France. There, the picture was grave as the septic knee joints were in various stages of joint destruction. What was the result of early prophylaxis in the treatment of these joints? I may say that in the winter of 1916, I saw penetrating wounds of the knee joint treated by means of the Thomas splint as soon as they were brought to the advanced dressing station by the stretcher bearers. They were cleaned up and put into the Thomas splint, and they went out on the Thomas splint. That remained on during the short time before they came into an active surgical zone. X-rays were taken and then the patient was transferred to the operating room of the Casualty Clearing Hospital. The wound was excised, the missile removed and the joint was washed out. Afterwards the joint was closed; except occasionally with a subcutaneous drainage, the Thomas splint was applied with extension. Very often a moulded splint prevented hyper-extension of the knee. Then the patient went on to the base. If there were any collections of pus, the wound could be incised and drained and left open; and if necessary, it could be kept open, sutured to the skin, or a criss-cross incision could be made. That was the method followed with these cases.

Regarding the metastatic cases, where other wounds were present or occasionally without other wounds, it was found wise to aspirate the joint, as a first measure. I had a striking example of that in a soldier who had lost one leg, and who had a stereptococcus infection of the other leg. Suddenly he developed a septic knee with high temperature, etc. We aspirated the knee four times, at intervals. At each operation, the pulse dropped, the temperature dropped, and the leukocytosis dropped. At the end of ten weeks, the knee had recovered complete function. We found that with the most careful watching, and using the Murphy drip and other means of drainage in every case where foreign material was used, it walled off the drainage abscesses collected away from the drain. In every case that came to amputation, such was found to be the case. Conservatism, with the use of the Thomas splint, has opened up a new era in the treatment of the knee joint.

A note of warning here is that when the joint requires to be relieved, incise freely and suture the synovia to the skin. This will allow flushing of the wound. I believe, with Willems, that early moderate movement of the joint should be carried out in most cases by the patient or by the surgeons.

I confess that I have not had any experience of early weight bearing on septic knee joint as advised by Willems.

Dr. Ralph R. Fitch, Rochester, New York: *Mr. President, Ladies and Gentlemen:* When immobilization of the knee joint is indicated, I agree with Dr. Ober that the Thomas splint is an excellent medium. He referred almost exclusively to the knee joints as seen in the Service. I shall not say anything about that side of it. As we see infected knee joints at present, I think that the greatest error that we make is to wait. A knee or other joint should be opened on suspicion of infection. I believe that the knee joint will stand more infection than we have ever given it credit for, and come out with good function also. With the local and constitutional signs of infection, I believe we should open it immediately. With the release of tension, a great many of these patients will get along without pain. In such cases, I think it is best not to immobilize, but merely put the leg on a pillow. A great

many will be comfortable, and can move the joint without pain. If there is pain, then I believe that the leg should be immobilized—preferably with the Thomas splint. Why some cases have pain and others have not, I do not know. I think that the drainage should not be put into a knee joint. I believe that when you begin cigarette draining or draining by tubes by putting them into the joint, you almost give up hope of good functional use of that joint. I believe not only that it is better to open these joints and let them drain of their own free will and accord, but that many will be saved if you do it early. Do not wait for forty-eight hours. If the joint is not infected you can do no harm by opening it, but give the joint a chance. When one is morally sure that good functional use will not persist after the infection has quieted down—when one is morally sure—I do not know when that time is: it varies in each case. But when one has reached that point, it is wise to open it with a large horse-shoe incision, take out the semi-lunar cartilage, take out the crucial ligaments, and put the leg on a double inclined plane, which is an old time practice, on wedges, with the sides on hinges, so that the dressing may be done easily. Then, with the Dakin solution in the wound, you can get granulating surfaces; and in a few weeks, you can do a formal resection of the knee joint. You will save the patient a great deal of time, practically obviate the danger of amputation or death, and give the patient a more serviceable leg than he would have had if you had allowed the infection to go on and the leg become stiffened throughout its full length. As the leg is apt to develop fibrous union, the knee is painful whenever the patient stubs his toe. Such reaction is easy, because the hamstring muscles are contracted and hold the bone surfaces face to face, giving a good strong bony union in a short time.

THE REMOVAL OF THE MENISCUS FROM THE KNEE-JOINT.

BY ALBERT H. FREIBERG, M.D., F.A.C.S., CINCINNATI, OHIO.

THE removal of a loose or torn meniscus from the knee is an operation quite frequently called for. It is desirable to have the joint cavity open for as short a period as possible in order that the chance of infection be reduced to a minimum. It is important that the whole of the meniscus be removed in order to avoid disagreeable interferences with function afterward, which are likely to result if a loose stub be allowed to remain. Unless the knee be opened very widely, it is difficult to remove the posterior extremity of the meniscus completely with ordinary knives or scissors; considerable time is usually spent in doing this and no little damage is done to the cartilaginous surface of the femur. In working through the usual short mesial incision with the knee flexed, we have to deal with a cavity of depth whose cross section is smallest where the posterior end of the meniscus must be severed.

It is not possible to help one's self to any considerable degree with retractors.

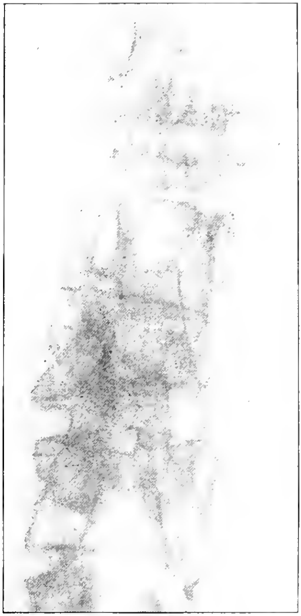
While working in Walter Reed General Hospital during the war, I designed a knife whose cutting edge was at an angle of 135° with the shank, its end being rounded instead of pointed, so that it was possible to cut with the extreme end of the knife as well as the blade itself. My friend, Dr. W. P. Carr of Washington, D. C., kindly made such a knife for me and it was at once evident upon use that it facilitated the operation greatly. I have used the instrument frequently with great satisfaction, and colleagues who have used it have urged this publication. It is important that the shank and handle should be long. Mine are two inches and five inches, respectively, in the model which I am now using.

MYELOMA OF THE VERTEBRAE.

BY W. G. TURNER, M.D., F.A.C.S., MONTREAL.

Multiple myeloma is a specific malignant tumor of the bone marrow arising, probably, from a single cell type and characterized chiefly by multiple foci of origin, a uniform and specific structure composed of plasma cells or their derivatives, rare metastases, albumosuria, and a fatal termination.

The definition is from Ewing—Neoplastic Diseases. His bibliography ¶ 283-9 is the most complete that I have noted. The early observers discussed the condition under various names. McIntyre, 1850, first described it under the name of "mollities ossium." He noted the presence of Bence-Jones albumose in the urine and many early observers noted the tendency of the disease to limit itself to the bone marrow and the resemblance to an infectious granuloma. Rusticky, 1873, first recognized the disease as a specific affection of the bone marrow and employed the term myeloma.

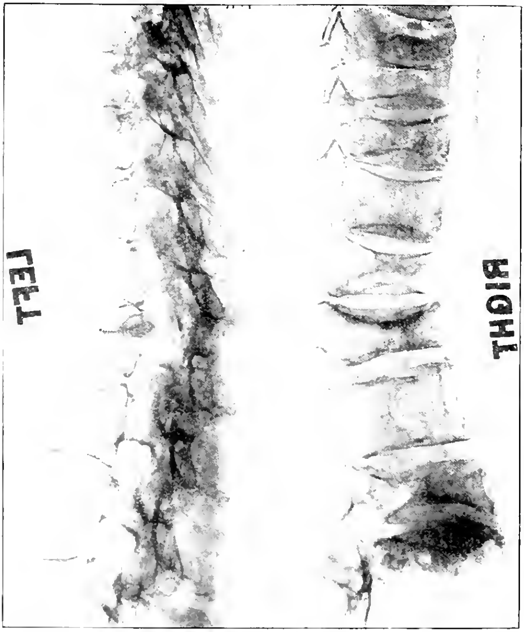


Extreme Rarefaction in X-Ray.

The ribs and sternum are the chief original seats of the tumors, while the vertebrae, skull, femur, pelvis and humerus are less frequently involved and in the order named.

Last year two cases at the Royal Victoria Hospital have come under my observation, in conjunction with Dr. W. F. Hamilton of the medical service.

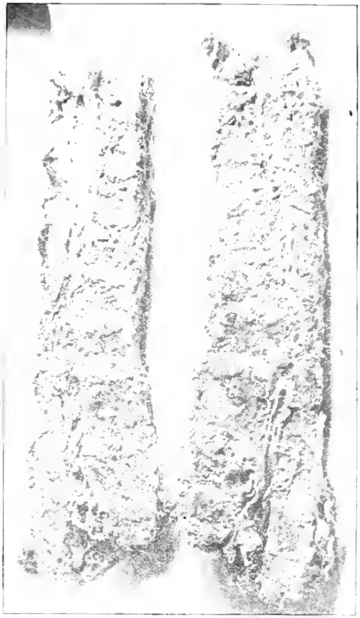
Case 1. Male, æt. 75,—a vigorous, healthy man, who in the summer of 1919 had arranged for a couple of months' golfing. About the middle of July, 1919, he had a severe fall and fractured his sixth rib, near the angle, right side. Although well strapped, severe pain persisted, with some tenderness. There were no lung or pleura signs. August 20, he was referred to me for severe pain in the back. The pain was very severe, gait very guarded, and he held himself erect with difficulty. The pain was referred chiefly to the lumbar region, third and



X-RAY SPECIMEN. BONY STRUCTURE A MERE SHELL.

fourth vertebrae, also to the dorsal region, sixth, seventh, eighth and ninth vertebrae and to the right about four inches along the sixth, seventh and eighth ribs. No deformity of the column was present. Dorsal decubitus gave some ease, ventral decubitus increased the pain. The tenderness was over the same regions but varied in intensity when tried three or four times. No girdle pain. Reflexes normal; no sensory change. Abdomen and thorax negative. Urine has small amount of albumen: sp. g. 1018. Prostate enlarged but not nodular. Owing to my absence from town I did not see him again until October 18. During that time patient had failed markedly, pain was constant and worse and he was admitted to the hospital.

Pain was much increased about the same segments. The tenderness was about the same as at first examination. Patient was now a bed patient. Vertebral column showed no deformity. No girdle pains, no paralysis, reflexes normal, no sensory change. Abdomen and thorax



PHOTOGRAPH OF SPECIMEN.

negative. There were now irrational intervals with longer lucid intervals. Urine showed definite albumen, no albumose found after repeated examinations. Temperature subnormal. Pulse 84 and regular. X-ray showed only marked bone atrophy. Blood showed 4,000,000 R. B. C., 8,120 W. B. C., 75% hæmoglobin, the other cells in normal percentage ratio. Wassermann negative. Patient failed gradually and died March, 1920, in coma.

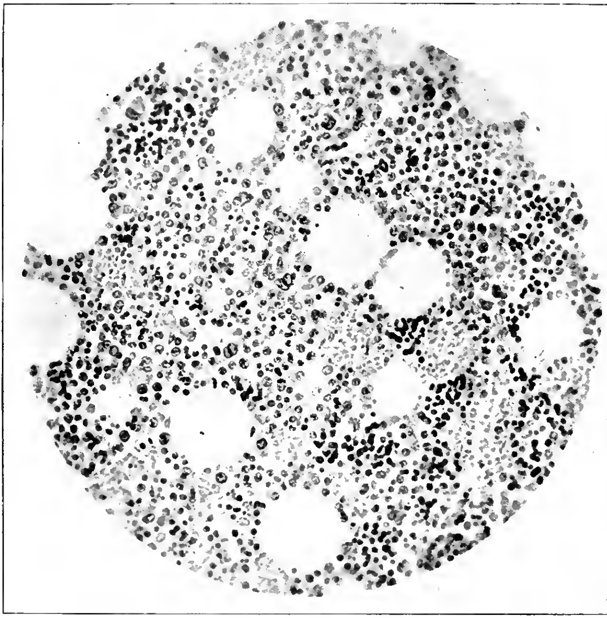
Diagnosis in October—Malignant tumor of vertebrae. Pathologist requested to make special examination of the vertebrae.

Autopsy, Dr. Crowdy, Royal Victoria Hospital.

Male, æt. 75 years. The rest of the body showed only senile change. No metastases found.

The Osseous System.

The clinical history directed attention to the vertebral column. Superficial examination revealed only slight enlargement of the lumbar



MYELOMA. x350.

vertebrae without any deformity, a condition which might be easily overlooked. On removal, however, and longitudinal section an interesting condition was found. Only a peripheral shell—very thin—of bone remained. The vertebrae were replaced by a soft reddish brown (myeloid) tissue, so soft that the finger could penetrate it. The intervertebral discs, however, were relatively intact and these, with the external shell of bone, held the column together. Examination of the ribs showed that a similar but less extensive process envolved them. They were so brittle as to crack easily on the slightest pressure.

Vertebrae.

The sections show a very cellular and vascular tumor. The cells on the whole are of a uniform type but vary in size and shape, many of them are granular, an occasional cell shows eosinophilic granules. The

nuclei are central or excentric, with coarse chromatic granules grouped around the periphery. The cells are divided by large blood channels and sinuses into groups and islands. There is no visible supporting stroma.

Diagnosis: Myelocytoma.

Case 2. Female, æt. 40. Married; three healthy children.

Admitted September 24, 1920. Had suffered from "tired feeling" in lower back for about one year. February, 1920, had a fall, followed by pretty constant pain between the shoulders. Some lameness and stiff back through the summer. In August, had a febrile attack for ten days. Pain in back increased up to date of admission. Previous health and family history negative.

Pain was the dominant complaint. This was referred to back, "between the shoulders" and to region between eighth dorsal to second lumbar vertebrae. Tenderness moderate over the same region. Patient a bed patient. There is no deformity of the spine. Heart, lungs and abdomen negative. Urine sp. g. 1018, small amount of albumen. No Bence-Jones albumose found in repeated examinations. No nerve signs. Reflexes normal. Wassermann negative. Blood, R. B. C. 4,000,000; W. B. C. 8,000; hæmoglobin 70%. Differential count showed no abnormal percentage of blood cells. Despite treatment, patient failed progressively. Pulse rapid and small, 120. Temperature subnormal.

October 24—"Pins and needles" sensation in legs and girdle pain at level of eighth dorsal vertebra. She also became more nervous and apprehensive. November 16—Paraplegia; double Babinski, and knee jerks, dulled sensation, retention of urine, incontinence of fæces. Irrational at times. The pain is very severe.

The patient failed rapidly and died December 30, 1920, in coma, with marked retraction of the head.

X-ray plates showed extreme bone atrophy. Bone salts appeared absent. Marked narrowing of lumbar vertebrae making the discs appear unusually prominent. No erosion noted.

Autopsy—partial—Dr. Crowdy.

Female, æt. 40 years. Autopsy limited to removal of portion of spine. The portion of spine removed included the sixth dorsal to the third lumbar vertebra. The piece of spine was then sectioned longitudinally. The intervertebral disks are markedly prominent and firm. The vertebrae, however, all show greater or lesser changes. The seventh, eighth, ninth, and tenth are in normal position and approximately normal in shape and size, but are much softer than usual, being easily broken into with a blunt instrument. The eleventh and twelfth vertebrae are distorted in shape. They are much narrower than normal towards the ventral surface, gradually widen out toward the dorsal surface and encroach upon the spinal canal so as to compress the cord and vertebral disk between these two vertebrae. The laminae immediately opposite this point are thin and compressed so that the canal at this

point shows a distinct obtuse angle. The irregular tumor like nodular greyish white masses, which are soft and brain-like in consistence, and the vertebrae themselves encroach on the spinal canal.

Sections taken from the soft white nodular masses seen in the lumbar vertebrae show a very cellular tumor growth replacing the normal cancellous bone and marrow. It is made up of a very uniform type of cell showing a round or oval nucleus with deeply staining chromatic granules with a tendency toward peripheral distribution. The protoplasm is uniformly and lightly staining, the nucleus being placed eccentrically. In some places the tumor is very vascular, showing wide and irregular areas of red blood cells in direct contact with the tumor cells. In other fields only an occasional blood channel is seen and here and there a minute spicule of bone. There is a minimum amount of reticular supporting tissue.

Diagnosis—Myeloma.

Clinical Course. Onset—moderate trauma but no contusion of vertebrae in either case.

Case 1 and Case 2—the dominant symptom was pain.

Pain. The pain was of a "boring" character and very constant. Moderate doses of morphine gave relief in each case for a few hours. At times there were marked exacerbations but in neither case did "spasm pain" appear. The pain was diffuse and in Case 1 would involve several vertebrae, frequently fifth to tenth. Dorsal and frequently first to fourth lumbar. Case 2 showed much the same type of pain, chiefly from third to sixth dorsal and from tenth dorsal to first lumbar. At other times pain was referred to the column from mid dorsal to fourth lumbar. Pain between the scapulae. In this last the pain was usually not so severe as when referred to a definite segment. Pain was more prominent at night. In Case 1 pain was also referred along the fifth, sixth, seventh, and eighth ribs to about four inches from the spine, especially on the left side.

Tenderness. This sign almost corresponded with the pain. Except in the later stages of Case 2 there was no particular localizing to any special one or two vertebrae.

Treatment. Fracture bed, Bradford frame. Radiant heat has no effect on the pain. Special dieting, open air, and general tonic treatment had no noticeable effect on general condition.

Nerve Signs. Case 1 showed no signs of root or cord pressure. Case 2, two months after admission, eight months from onset, had "pins and needles" sensations in legs. Three weeks later definite signs of paraplegia, which in another week involved bladder (retention) and

rectum (involuntary). Hyperæsthetic zone about level of tenth dorsal vertebra. No clonus. Girdle pain about level of eighth dorsal vertebra noted about same time as the formication. The paraplegia was permanent.

Mental Signs. Case 1 became very irrational with moderately long lucid intervals, beginning $3\frac{1}{2}$ months after onset. The last two months very short lucid intervals. Quite tractable and endured pain with courage. Case 2—Extreme desire to recover but very apprehensive of fatal result. Very depressed and nervous at intervals. Six weeks before death memory not accurate and two weeks later was irrational for short intervals.

Heart. In Case 2 the accelerated pulse was definitely noted. No particular irregularity until the later stages. Case 1 twice suddenly fell to ground—collapse was quickly recovered. Case 2—During last three months had frequent "sinking turns," during which the pulse became faster—110 to 120—and weaker. The rapid pulse appears to be an important observation in some cases.

Temperature. In each case was subnormal until the late stages.

Urine. In each case repeated examinations showed a small amount of albumen. No Bence-Jones albumose present in either case. Case 2—As paraplegia became pronounced, developed cystitis. Emaciation progressive.

Blood Picture. No particular anemia. Red blood cells, 4,000,000; hæmoglobin, 70 to 75%. A slight leucocytosis Case 1, 8500; Case 2, 8000. In neither case was there an increase of myelocytes. There was no liver or spleen enlargement, no enlarged nodes in either case. Case 1—Prostate negative. Case 2—Pelvis negative.

X-ray Findings. The extreme atrophy is a marked feature. In Case 2 it was more pronounced, but in each case the rarefaction was extreme. Case 1 showed a nodule on eighth rib. Case 2 appeared to have absence of bone salts. The discs were regular but several of the vertebrae were very much narrowed and flattened. No lipping. Wassermann negative in each case.

Course. Progressive severe pain, progressive emaciation, moderate cachexia, diarrhœa, coma in Case 1 for some days. Case 2—Paraplegia, cystitis, death. Duration— Case 1, death eight months after onset of symptoms; Case 2, death ten months after onset.

ON THE CAUSE OF COXA PLANA.

BY DR. MURK JANSEN, LEIDEN.

In the first publication on "Legg's Disease," or preferably "Coxa Plana," which I read—it may have been 1911—I was struck by a lateroposition of the femoral head in its socket, visible in the illustrations of the described cases. Later publications have contributed to confirm my view that a *congenital lateroposition of the femoral head* associated with due preservation of the acetabular roof and its rim was the primary cause of Legg's disease. In 1918 or 1919, I brought forward this opinion at a meeting in England, and during my the last few months I have collected new facts by going over all my hip cases, old and young, and repeating examination and x-ray photographs in all available cases.

I find the way in which the condition develops is as follows:

The head by its lateral displacement—often visible in the skiagram, especially in not too advanced cases—is made to bear the body-weight on a small lateral portion of its surface only. It is like a billiard ball, which when displaced laterally in a close-fitting cup so that the centres of ball and cup are at some distance from each other, would be in contact with the cup only along a line of its surface. Hence in lateropositio coxae the stresses of body-weight and muscle pull are concentrated on a small lateral portion of the head, whilst its medial part is relieved. (Fig. 1.) This involves excess of stress, first on the lat-


FIG. 1.

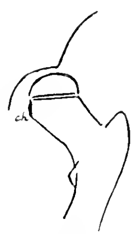


FIG. 2.

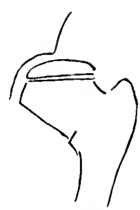


FIG. 3.


FIG. 4.

eral part of the growth disc, and second, on certain portions of the femoral neck, with relief of the other parts.

1st. It is well known that under certain circumstances* excess of

* Cf. Feebleness of Growth and Congenital Dwarfism. London. Oxford Medical Publications, 1921.

pressure on growth discs will retard growth. Now, in the development of coxa plana the growth disc is seen to draw nearer the horizontal position. (See Fig 2.) A kind of chin (Fig. 2 ch.) forms. The latter may partly be due to the greater length growth of the neck medially, and partly to change of form the neck shows apart from growth, due to

2nd. Excess of stress passing through a portion of the femoral neck. —It is well known† that excessive weight-bearing on bone leads to absorption of lime salts and secondary plasticity. Now the femoral neck may normally be considered to be about the narrowest area through which as much of the body-weight passes. The lumbar vertebrae, for instance, though they have to bear a smaller portion of the body-weight, have a greater transverse section. So relief of part of this area may soon lead to over-exertion for the rest. This may account for the fact that the neck shortens and widens—one of the characteristic features in coxa plana.

It is needless to say that both the horizontal position of the growth disc (head in neck) and the widening of the neck will evolve more readily in cases of feebleness of growth (cf. Feebleness of Growth l.c.). Injurious agents, either before or after birth, which enfeeble the power of growth, enhance the danger of the above deformations.

As the transverse section of the neck increases, the growth disc and head are spread out over a larger area. (See Fig. 3.) The quicker the widening evolves, the more disc and head must tend to bursts and rents and, as regards the disc, to a division into flakes. And it seems plausible that at this stage, jumping end even ordinary walking may bring about the characteristic clefts the skiagram displays. (Fig 4.)

This explanation seems to me in harmony with all the facts I know. For example:

a. That coxa plana, though congenital in its primary cause, develops only after some years of walking: the neck must be widened out before the characteristic flattening and cleaving will occur.

b. That coxa plana is often seen to develop a short time after infectious diseases have been sustained: the injurious agents have temporarily enfeebled the power of growth of the bone and contributed to the plasticity of existing bone.

† Cf. Bone Formation, Its Relation to Tension and Pressure. Manchester University Press, 1920.

c. That it is so closely associated with congenital dislocation of the hip as to sometimes alternate with it or also to follow after hip reduction.

d. That signs of local infection are alien to the process.

It is evident that the laws and rules of bone growth, bone formation and deformation have to be borne in mind for the right understanding of the above considerations. The phenomena of the development of coxa plana are in full accord with these rules, and thus contribute to establish them. For further details of these rules I may refer to the books quoted above.

Correspondence

OPERATIVE TREATMENT OF SCOLIOSIS.

September 13, 1921.

Dr. E. G. Brackett, Editor, *Journal of Orthopædic Surgery*,
166 Newbury St., Boston, Mass.

Sir:

In a paper on the operative treatment of scoliosis printed in the July number of the Journal, I called attention to the advantage of hyperextension of the spine in ambulatory treatment by jackets, and particularly by the convex stretcher frame, both before and after the operation.

In the class of cases under consideration, the capacity of the chest on the convex side, diminished by the rotated spine and increased inclination of the ribs, has been, in many instances, still further lessened by the constriction and pressure incidental to the correction of the lateral distortion. Fixation on the convex frame by contrast increases the expansion of the chest, while the pressure exerted tends to flatten the projecting ribs and to force them forward. Hyperextension also elongates the spine and thus straightens the compensatory curves, and should lessen the resistance of the primary deformity.

The photograph shows the apparatus in actual use in my service at the Hospital for Ruptured and Crippled. It may be noted that in a number of cases weights are attached to the pelvis or limbs and to the head, and in several, there is anterolateral traction on the trunk in addition. Traction is of service in the paralytic deformities of young children, particularly for distortion of the pelvis, but in the class of patients described in the paper, it is doubtful if it is of value except, perhaps, by fixing the patient more securely, to increase the posterior pressure on the projecting ribs.

Very truly yours,

ROYAL WHITMAN.

CARPAL INJURIES.

San Francisco, California, October 28, 1921.

Dr. E. G. Brackett,
Editor, Journal of Orthopedic Surgery,
Boston, Mass.

Dear Doctor:—

During the past two and a half years I have observed in six cases of carpal injuries, a persistent pain beginning at the lower end of the ulna and extending along the ulnar side of the wrist and hand and ending about the proximal phalanx of the little finger. The cases in which this has been observed are:

Fracture of the navicular alone—four. (Three of these operated upon, removal of both fragments. The fourth not operated upon.)

Fracture of the semilunar—one. (Two operations, the first removal of the semilunar, the second removal of the navicular.)

One case in which the man had been operated upon four times by as many surgeons who had removed most of the bones of the wrist. The fifth operation, done by myself, was an Ely fixation of the wrist.

All of these patients had pain in the same location, persisting for months, pain worst when the hand was prone upon the table and then supinated, in two cases that lasted over a year and in one over two years. There was an area of hyperaesthesia corresponding fairly closely to the area of pain.

I can find no adequate explanation of this phenomenon based on anatomy. I would greatly appreciate knowing if any of your readers have observed similar cases and also if any of them can offer an explanation as to the mechanism of the pain.

Very sincerely yours,
ARTHUR L. FISHER.

CONCERNING FRACTURES OF THE NECK OF THE FEMUR.

To the Editor,
Journal of Orthopaedic Surgery,
Boston, Mass.

Sir:

Dr. Adams' paper in the last issue of the Journal entitled "An Analysis of Seventeen Fractures of the Neck of the Femur" is naturally of particular interest to me. As an analysis, it is rather indefinite. Apparently the patients were of the unfavorable, unrepresentative, hospital class, since in but ten cases was "reduction" attempted. In eight of these the abduction method was employed, but in only four instances under general anaesthesia, nor is it stated that the reduction was verified by x-ray examination.

The result was good both from the anatomical and functional standpoint in seven cases and fair in five others. Although the relation of the method employed to the result obtained is not specified, it may be assumed that the six cases in which reduction was not attempted were not included in the first class. There was one death from pneumonia, but its relation to the treatment is not stated.

I infer from the analysis that Dr. Adams recognizes the technical superiority of the abduction method as a treatment for the fracture, but thinks that the condition of the patient makes it impracticable in about the proportion of cases reported. It may be of interest, therefore, in this connection, to call attention to a similar report of twenty consecutive cases of intracapsular fracture of the femur treated by the abduction method at St. Agnes' Hospital, Philadelphia (*Annals of Surgery*, June, 1921). Eighteen of the patients were from sixty to eighty years of age. In five there was incontinence of urine and faeces, and in six bed sores were present on admission, yet there were but two deaths: one a woman of eighty, semiconscious on admission; the other a sufferer from cardio-renal disease. In nine full function was restored. In eight there was slight impairment of function, and in only five instances was a cane used in locomotion.

The functional results of Dr. Adams' cases may be contrasted with those of Scudder of a similar number of patients treated at the same institution but of a better type, since but three were over sixty years of age.—"yet in

but two instances could the limb be said to be functionally useful." Of sixty cases reported by an earlier writer (Robert Smith), it is stated that thirty died within eight weeks of the injury. He concludes very naturally that "our prognosis in cases of fracture of the neck of the femur must always be unfavorable. In many cases the injury proves fatal, and in all the functions of the limb are forever impaired."

I think that the improved results, both as to function and to mortality, may be ascribed to the efficient treatment of the fracture, and may be accepted as evidence in favor of my contention that in the great majority of cases the abduction treatment which relieves pain and prevents hypostatic congestion and bed sores, is less dangerous than other methods, or even than "life saving" neglect; and that neither advanced age nor the situation of the fracture precludes success, if the opportunity is assured.

I cannot agree, therefore, with Dr. Adams "that there is no class of fractures that requires better judgment as to choice of treatment." On the contrary, it seems to me that there is no class of fractures in which the choice of treatment is so obvious.

The most definite statement in Dr. Adams' paper is, that "the Whitman plasters were suspended in Balkan frames." In my practice the patient is placed on an inclined plane by raising the head of the bed, and is systematically turned at intervals to relieve pressure, and I can see no advantage whatever in suspension.

I call attention to this point because an important feature of the abduction treatment, apart from its mechanical efficiency, is its simplicity and general adaptability. In its application no apparatus is essential, the materials for splinting are always at command, and the treatment from beginning to end is under the control of the surgeon. Thus neither hospital care nor skilled nursing is essential to success.

I note in the discussion that the danger of overabduction is mentioned. This must be very remote in the treatment of recent fractures if one takes the range on the sound side as the model. The real danger is too little abduction either to reduce the deformity or to assure security.

The stiff knee mentioned as a result of prolonged fixation is in my experience of little importance, possibly because the spica in the final adjustment is bent slightly toward flexion at this joint. When it is removed the patient remains in bed until discomfort has subsided, and until fair muscular control has been regained under massage and active and passive movements. As a rule, a free range of motion at this joint is established long before weight-bearing is permitted.

November, 1921. ROYAL WHITMAN.

Note

PROF. DR. SLOMANN, whose paper, "On Coalitio Calcaneo-Navicularis," was published in the November *Journal of Orthopædic Surgery*, has recently written to the *Journal* as follows:

I have had the opportunity lately to make one more observation with reference to the anomaly. Occupied with the study of the os vesalianum tarsi, I found in a paper published by Gelinsky in *Fortschritte der Röntgenstrahlen* (Vol. VIII, 1904-5) the x-ray pictures of a case, in which he has found an os vesalianum in both feet of a young subject, and to this he adds the remark: "*An den Tarsalknochen sind keine Besonderheiten.*" After this it was very interesting for me to observe, that a quite unquestionable (if perhaps not quite typical) coalitio calcaneo-navicularis is clearly present in these pictures in both feet. I think that such a case may perhaps give the key to the singular fact that this anomaly has been hitherto almost or totally ignored in the Röntgen literature.

Current Orthopaedic Literature

FRACTURES OF TRANSVERSE PROCESSES OF THE LUMBAR VERTEBRAE. George G. Davis. *Surg., Gyn., and Obstet.*, September, 1921, p. 272.

Fractures of the transverse processes of the lumbar vertebrae are not infrequent injuries, but have been frequently overlooked. Fractures may be caused by direct or indirect violence, or may be of developmental origin, according to various authorities. The embryology and anatomy is discussed. The writer is of the opinion that practically all cases are due to direct violence. He reports ten cases varying in age from 23 to 54 years of age. He shows roentgenograms and gives short reports of each case. "Backache" is the chief symptom. The pain is well localized, constant, and does not radiate. In some cases the symptoms are mild and the patient may return to work shortly after injury. The condition is often associated with osteoarthritis of the spine.—*F. G. Hodgson, Atlanta, Ga.*

MOBILIZATION OF THE ELBOW BY FREE FASCIA TRANSPLANTATION; WITH REPORT OF THIRTY-ONE CASES. W. Russell MacAusland. *Surg., Gyn., and Obstet.*, September, 1921, p. 223.

The causative factors of ankylosis are discussed. Author considers the elbow the joint most suited for arthroplasties. The history of arthroplasty, the development of the modern technique, and cases reported in the modern literature are gone into quite fully. The operation is contraindicated until epiphyseal growth is complete. Infectious cases should not be operated upon until all signs of the active process have ceased. It is questionable if a tuberculous joint should be operated upon, certainly not until a number of years after it has been healed. Operative technique is carefully described and each step well illustrated. He uses a large, free flap of fascia lata to cover the raw surface of the end of the humerus. The head of the radius is not removed. After closing the wound, the arm is put up in a plaster cast, elbow less than a right angle. Stress is laid upon the after-care. Passive motions are begun in about ten days, gentle massage at three weeks, baking at six weeks. Occasionally, manipulation under anæsthetic is required, and in a few cases, exuberant bone was removed at a secondary operation. The after-treatment was continued for months.

Twenty-eight cases are reported in full. There are a large number of good illustrations and roentgenograms of cases. A bibliography is appended. The article is a noteworthy contribution to the subject of arthroplasty. The results obtained seem to justify the operation of arthroplasty of the elbow, in spite of the fact that some authorities are still in favor of excision.—*F. G. Hodgson, Atlanta, Ga.*

Bone Atrophy: An Experimental and Clinical Study of Changes in Bone which Result from Non-use. Nathaniel Allison and Barney Brooks. *Surg., Gyn., and Obstet.*, September, 1921, p. 260.

This article should not be abstracted. It is so well worth while that it should be read in its entirety by everyone interested in bone pathology. There are a number of good illustrations and several interesting tables. The purpose of the experimental and clinical study is to determine the effect of non-use of bones as it concerns:

1. x-ray photographs; 2. gross and microscopical anatomy; 3. chemical composition; 4. breaking strength; 5. growth; 6. regeneration.

Dogs were used. Three methods were used to prevent the use of the foreleg: *a.* Section of the brachial plexus—13 experiments; *b.* Excision of the upper end of the humerus—7 experiments; *c.* Plaster of Paris fixation—4 experiments.

Discussion: Regardless of the method used to cause non-use, the changes in the bone were the same. The degree of atrophy of the bone was directly proportional to the degree of non-use. There is no evidence warranting the assumption that any disease process plays any rôle in the production of bone atrophy other than its effect on use. Bone atrophy is not the result of diminished circulation of blood. Bone atrophy is an active process, and the circulation of the blood is necessary to its progress. The process of bone atrophy is not a change in the characteristics of bone as a substance. The process of bone atrophy is a change in the amount of bone present. This affects the size, shape, thickness, length, weight, and texture of the whole bone, and accounts for its changes in gross anatomy, x-ray photographs, breaking strength, and chemical composition. The chemical composition, breaking strength, and regeneration of *bone* remains unchanged. The above conclusions are logically drawn from all the experiments and agree with clinical experience.—*F. G. Hodgson, Atlanta, Ga.*

Intrapelvic, Extra-Peritoneal Resection of the Obturator Nerve. Method of Selig. L. Kreutz. *Archiv. Orthop. und Unfalls Chir.*, Vol. xix, No. 2, July, 1921.

Lauenstein, in 1893, was the first to report a resection of the obturator nerve for the purpose of eliminating the adductors. Up to the time of Selig's publication, the technique was extra-pelvic, including the methods of Stoffel. Selig, in 1914, proposed to resect the nerve before it passes the foramen obturatum. He recommends the following routes:

1. Abdominal incision at the edge of the rectus muscle,
2. Incision through the rectus, and
3. Incision in the median line.

Working laterally or through the rectus muscle, the transverse fascia, together with the peritoneum, is pushed off, the peritoneum separating easily. As soon as the latter has been separated up to the lower crest of the os pubis, the heavy round strands of the obturator nerve can be felt. The superincumbent vessels must be isolated before the nerve is sectioned.

Of thirteen cases operated upon by the author, all were spastic diplegias; among these, four Little's disease.

In two cases, the resection of the obturator nerve was accomplished from two lateral incisions, in six cases, it was accomplished from one common incision in midline, and in five cases, a supra-spmphyseal transverse section was carried out.

Twenty-four hours before the operation, the abdominal skin and the adjacent parts of the thighs are thoroughly cleansed and before operation the field is covered with iodine and alcohol.

If operating from two lateral incisions, at first incision is made five inches in length on the outer border of the rectus, ending somewhat above the symphysis, the fascia is sectioned and the rectus muscle retracted medially. Then the peritoneum is pushed upward and the median surface of the horizontal ramus of the os pubis is prepared by blunt dissection. The foramen obturatum is ascertained by palpation. The nerve is carefully isolated from the accompanying vessels. Then follows resection of about 3 c.m. of the nerve, suture of the fascia, and closure of the wound.

In operations from a common incision in the linea alba, the incision begins immediately above the symphysis and reaches upward two-thirds the distance to the umbilicus In the lower third of the incision, the insertion of the pyramidal muscles, and in the upper third, the bladder becomes visible. The latter is retracted upward and one now proceeds to the isolation of the os pubis as in the lateral incision; the nerve is isolated, pulled up by blunt hook and 3 cm. are resected.

Transverse incision: The incision is made three fingers above the symphysis from one anterior superior spine to the other. The incision is curved with concavity pointing toward the umbilicus. Section of sub-cutaneous fat, division of the recti muscles, of the tendons of the obliqui, and of the transversus are done. One then proceeds upon the transverse fascia laterally to the pelvic wall and palpates the foramen obturatum. In doing so, the peritoneum is bluntly separated and retracted upward. The isolation and the resection of the nerve is carried out as in the other incisions. In all cases, a double hip-spica was applied in abduction.

In regard to the muscle function remaining after dissection of this nerve, the author points out that outward rotation is still possible owing to the preservation of the nerve supply of the gemelli, of the obturator internus, etc

There is also preservation of the power of adduction because the posterior or flexor group of the thigh muscles has an adducting component, as has also the gluteus maximus. The author recommends not to attempt a resection on patients less than two and one-half years of age. In regard to the after-treatment it is emphasized that the abduction hip spica should remain from fourteen to eighteen days. Following the removal of the cast, one should start at once with walking exercises and with active and passive abduction and adduction movements.

The author does not approve of a protracted plaster of Paris fixation.

In two cases in which the double hip-spica was allowed to remain five weeks, an abduction contracture had developed

Splints are worn to meet the secondary deformities such as knock-knees, or knock-ankles. Flexion contractures of the hip and of the knee will often require additional operative interference. A. *Steindler, Iowa City, Iowa.*

POSTURE IN RELATION TO MEDICAL AND SURGICAL PROBLEMS. John Allan Talbott. *Virginia Medical Monthly*, September, 1921.

The author calls attention to the vast percentage of physically unfit among the young men of draft age in this country, citing the fact that in the State of Massachusetts, 46 per cent. of the drafted men were refused on account of physical disability. Many of these, however, had disabilities which were remediable, such as backache, weak feet, infected teeth, et cetera. The experience of the recent war demonstrated the fact that many became physically disabled while in the service, and by training, particularly under the observation of orthopaedic surgeons, were benefited and later returned to active service while others were placed at work, which they were able to do, behind the lines. He cites from Lloyd Brown, that of the 746 men at Harvard, 80 per cent. showed postural defects. While the author does not go into the surgical and medical problems relating to poor posture, he has mentioned an important subject and brought to the attention of the profession again the importance of correct posture, especially with those unfortunate individuals who suffer from such conditions as visceroptosis, et cetera, and whose problems are unsolved and little benefited by usual treatment.—*H. W. Meyerding, Rochester, Minnesota.*

A WORK CHAIR. A. M. Emmons and J. E. Goldthwait. *Journal Industrial Hygiene*, September, 1921.

The author has given us a comfortable as well as substantial work chair, and one which it is to be hoped will gradually find its way into the various educational institutions and ultimately into the workshops of this country. The authors give the description together with the measurements and a drawing of the chair, so that it can easily be made. There are a number of illustrations, demonstrating faulty position, such as is frequently seen among stenographers, or those who work long hours at the typewriter or desk.—*H. W. Meyerding, Rochester, Minnesota.*

KYPHOSIS DORSALIS JUVENILIS. H. Scheuermann. *Zt. Orthop. Chir.*, Vol. xli, No. 4, June, 1921.

The author considers in his discussion on dorsal kyphosis the real sagittal deformities of the fixed type in contradistinction to the round-shoulder, which is a postural anomaly which may be corrected actively or passively. His series contains 105 cases; of these, 60 were pure antero-posterior curvatures, whereas 45 were complicated with slight lateral deviations. The lateral deviations appeared as often to the right as to the left and seemed to be accidental complications. It is noteworthy that of his cases 88% concerned boys and only 12% girls, which is almost the converse of the conditions prevailing in lateral curvature. The dorsal kyphosis appears usually in the ages from 15 to 17. It involves young people in the first years after the school period who very often are exposed to considerable physical work. Most commonly it is noted that the curvature develops in the course of six months to a year, and cases are not rare in which two or three months are given as the period of development.

According to the author, this deformity was first described by Schanz, in 1911, who called it the Kyphosis of the Apprentices, indicating an occupational origin. This deformity has nothing in common with traumatic kyphosis or with osteoarthritic conditions. Very scant consideration is given to this deformity in the ordinary text-books and especially there is nothing said about the etiology of the deformity.

The author mentions that H. Virchow described a wearing off of the basal surfaces of the vertebrae in a manner by which the epiphyseal discs become smaller and smaller until they are entirely worn off. This condition he claims to have found in some tribes of the Australian negroes who maintain a stooping attitude. The author believes that in the deformity found under his observation, similar attitudinal or occupational elements may have come into play and he has investigated the x-ray findings with a view of obtaining light in regard to the pathogenesis of this deformity. In later childhood, the body of the vertebra produces epiphyses which finally give the body its definite form. These epiphyses are not solid discs but have the shape of rings which are broadest at the anterior border of the body, and smallest at the posterior. Before the formation of these epiphyseal rings, the basal surfaces of the vertebrae are convex and the vertebral discs accordingly concave. After the appearance of the epiphyseal rings, the basal surfaces of the vertebrae are concave and the epiphyseal discs, accordingly, convex. The fusion of the discs with the bodies occurs between 22 and 24 years of age. Evidences of epiphyseal rings are observed as early as at 11 years. The calcification begins at the anterior border of the vertebrae and proceeds gradually backward. If one studies the x-ray picture of a typical dorsal kyphosis in the side view, one notices in the more acute period or within the first half-year, that the vertebral bodies which correspond to the most concave portion of the curve appear considerably lower in front than behind. The vertebral bodies distinctly assume a wedge shape. At the anterior border, one notices the epiphyseal discs not as a small triangular portion as usual but as a broad and irregular contoured mass. The question is: Which of the two facts is to be considered primary—the wedge-shaped formation of the vertebrae with following kyphosis, or the kyphotic curvature of the vertebra due to muscular insu ciency with following secondary wedge-formation? According to the author's opinion, there is no doubt that the trouble starts in the growth of cartilages of the epiphysis, and for this reason the author protests against the name of kyphosis muscularis. He draws a parallel between this condition and the osteochondritis deformans juvenilis of the hip to the extent that he proposes for this deformity the name of osteochondritis deformans juvenilis dorsi.

There exists no effective treatment of this deformity. Several attempts made by the author to correct the deformity by plaster casts applied in lordotic position of the body failed. As soon as fixation is accomplished, it is impossible to re-establish normal conditions, but during the earlier periods when the patient complains of pain in the back, it is possible to give relief by extension followed by plaster of Paris fixation. A. *Steindler, Iowa City, Iowa.*